COUNTY OF SAN DIEGO
SWMP – MAJOR

REDDING MINOR SUBDIVISION
TPM 21112

For:

#08-116
Ms. Jane Redding
13490 E. Wildcat Way
Prescott Valley, AZ 86314

REVISION 1: March 11, 2009
ORIGINAL DATE: August 8, 2008

Storm Water Management Plan
For Priority Projects
(Major SWMP)

The Major Stormwater Management Plan (Major SWMP) must be completed in its entirety and accompany applications to the County for a permit or approval associated with certain types of development projects. To determine whether your project is required to submit a Major or Minor SWMP, please reference the County's Stormwater Intake Form for Development Projects.

Project Name:	REDDING MINOR SUBDIVISION
Permit Number (Land Development Projects):	TPM 21112
Work Authorization Number (**CIP only**):	
Applicant:	MS. JANE REDDING
Applicant's Address:	PLEASE SEE COVER SHEET
Plan Prepare By (*Leave blank if same as applicant*):	WYNN ENGINEERING, INC.
Date:	MARCH 11, 2009
Revision Date (If applicable):	

The County of San Diego Watershed Protection, Storm Water Management, and Discharge Control Ordinance (WPO) (Ordinance No. 9926) requires all applications for a permit or approval associated with a Land Disturbance Activity to be accompanied by a Storm Water Management Plan (SWMP) (section 67.806.b). The purpose of the SWMP is to describe how the project will minimize the short and long-term impacts on receiving water quality. Projects that meet the criteria for a priority development project are required to prepare a Major SWMP.

Since the SWMP is a living document, revisions may be necessary during various stages of approval by the County. Please provide the approval information requested below.

Project Stages	Does the SWMP need revisions?		If YES, Provide Revision Date
	YES	NO	
TENTATIVE PARCEL MAP		X	

Instructions for a Major SWMP can be downloaded at
http://www.sdcounty.ca.gov/dpw/watersheds/susmp/susmp.html

Completion of the following checklists and attachments will fulfill the requirements of a Major SWMP for the project listed above.

PROJECT DESCRIPTION

Please provide a brief description of the project in the following box. Please include:

- Project Location
- Project Description
- Physical Features (Topography)
- Surrounding Land Use
- Proposed Project Land Use
- Location of dry weather flows (year-round flows in streams, or creeks) within project limits, if applicable.

THE PROJECT SITE IS LOCATED AT THE END OF PUEBLA STREET IN THE ESCONDIDO AREA OF THE COUNTY OF SAN DIEGO. THE PROJECT PROPOSES TO SPLIT ONE RESIDENTIAL LOT INTO THREE RESIDENTIAL LOTS.

THE EXISTING TOPOGRAPHY OF THE SITE IS AT THE TOP OF A SMALL HILL THAT IS PART OF A +/-99 ACRE DRAINAGE BASIN. THERE IS AN AREA OF W00-YEAR FLOOD INUNDATION ALONG THE SOUTHEASTERLY PROPERTY LINE. THIS IS ILLUSTRATED ON THE TENTATIVE PARCEL MAP, PRELIMINARY GRADING PLAN, THE PRELIMINARY HYDROLOGY STUDY, AND THE BMP EXHIBIT INCLUDED FOR REFERNCE IN ATTACHMENT E.

THE EXISTING LAND USE IS RESIDENTIAL AND THE PROJECT DOES NOT PROPOSE TO CHANGE THIS.

PRELIMINARY DESIGN HAS NOT PROVIDED ANY EVIDENCE OF DRY WEATHER FLOWS ON THE PROJECT SITE.

PRIORITY DEVELOPMENT PROJECT DETERMINATION

Please check the box that best describes the project. Does the project meet one of the following criteria?

Table 1

PRIORITY DEVELOPMENT PROJECT	YES	NO
Redevelopment that creates or adds at least 5,000 net square feet of additional impervious surface area and falls under one of the criteria listed below.		X
Residential development of more than 10 units.		X
Commercial developments with a land area for development of greater than 1 acre.		X
Heavy industrial development with a land area for development of greater than 1 acre.		X
Automotive repair shop(s).		X
Restaurants, where the land area for development is greater than 5,000 square feet.		X
Hillside development, in an area with known erosive soil conditions, where there will be grading on any natural slope that is twenty-five percent or greater, if the development creates 5,000 square feet or more of impervious surface.	X	
Environmentally Sensitive Areas (ESA): All development located within or directly adjacent to or discharging directly to an ESA (where discharges from the development or redevelopment will enter receiving waters within the ESA), which either creates 2,500 square feet of impervious surface on a proposed project site or increases the area of imperviousness of a proposed project site to 10% or more of its naturally occurring condition. "Directly adjacent" means situated within 200 feet of the ESA. "Discharging directly to" means outflow from a drainage conveyance system that is composed entirely of flows from the subject development or redevelopment site, and not commingled with flows from adjacent lands.		X
Parking Lots 5,000 square feet or more or with 15 parking spaces or more and potentially exposed to urban runoff.		X
Streets, roads, highways, and freeways which would create a new paved surface that is 5,000 square feet or greater.		X
Retail Gasoline Outlets (RGO) that meet the following criteria: (a) 5,000 square feet or more or (b) a projected Average Daily Traffic (ADT) of 100 or more vehicles per day.		X

Limited Exclusion: Trenching and resurfacing work associated with utility projects are not considered Priority Development Projects. Parking lots, buildings and other structures associated with utility projects are subject to the WPO requirements if one or more of the criteria above are met.

If you answered **NO** to all the questions, then **STOP**. Please complete a Minor SWMP for your project.
If you answered **YES** to any of the questions, please continue.

HYDROMODIFICATION DETERMINATION

The following questions provide a guide to collecting information relevant to hydromodification management issues.

Table 2

	QUESTIONS	YES	NO	Information
1.	Will the proposed project disturb 50 or more acres of land? (Including all phases of development)		X	If YES, continue to 2. If NO, go to 6.
2.	Would the project site discharge directly into channels that are concrete-lined or significantly hardened such as with rip-rap, sackcrete, etc, downstream to their outfall into bays or the ocean?			If NO, continue to 3. If YES, go to 6.
3.	Would the project site discharge directly into underground storm drains discharging directly to bays or the ocean?			If NO, continue to 4. If YES, go to 6.
4.	Would the project site discharge directly to a channel (lined or un-lined) and the combined impervious surfaces downstream from the project site to discharge at the ocean or bay are 70% or greater?			If NO, continue to 5. If YES, go to 6.
5.	Project is required to manage hydromodification impacts.			Hydromodification Management Required as described in Section 67.812 b(4) of the WPO.
6.	Project is not required to manage hydromodification impacts.			Hydromodification Exempt. Keep on file.

An exemption is potentially available for projects that are required (No. 5. in Table 2 above) to manage hydromodification impacts: The project proponent may conduct an independent geomorphic study to determine the project's full hydromodification impact. The study must incorporate sediment transport modeling across the range of geomorphically-significant flows and demonstrate to the County's satisfaction that the project flows and sediment reductions will not detrimentally affect the receiving water to qualify for the exemption.

STORMWATER QUALITY DETERMINATION

The following questions provide a guide to collecting information relevant to project stormwater quality issues. Please provide the following information in a printed report accompanying this form.

Table 3

	QUESTIONS	COMPLETED	NA
1.	Describe the topography of the project area.	X	
2.	Describe the local land use within the project area and adjacent areas.	X	
3.	Evaluate the presence of dry weather flow.	X	
4.	Determine the receiving waters that may be affected by the project throughout all phases of development through completion (i.e., construction, long-term maintenance and operation).	X	
5.	For the project limits, list the 303(d) impaired receiving water bodies and their constituents of concern.	X	
6.	Determine if there are any High Risk Areas (which is defined by the presence of municipal or domestic water supply reservoirs or groundwater percolation facilities) within the project limits.	X	
7.	Determine the Regional Board special requirements, including TMDLs, effluent limits, etc.	X	
8.	Determine the general climate of the project area. Identify annual rainfall and rainfall intensity curves.	X	
9.	Determine the soil classification, permeability, erodibility, and depth to groundwater for Treatment BMP consideration.	X	
10.	Determine contaminated or hazardous soils within the project area.	X	
11.	Determine if this project is within the environmentally sensitive areas as defined on the maps in Appendix A of the *County of San Diego Standard Urban Storm Water Mitigation Plan for Land Development and Public Improvement Projects.*	X	
12.	Determine if this is an emergency project.	X	

PLEASE REFER TO SECTION 1.0 OF ATTACHMENT I - SWMP ADDENDUM FOR ANSWERS TO THE QUESTIONS IN TABLE 3 (ABOVE).

WATERSHED

Please check the watershed(s) for the project.

☐ San Juan 901	☐ Santa Margarita 902	☐ San Luis Rey 903	☐ Carlsbad 904
☒ San Dieguito 905	☐ Penasquitos 906	☐ San Diego 907	☐ Sweetwater 909
☐ Otay 910	☐ Tijuana 911	☐ Whitewater 719	☐ Clark 720
☐ West Salton 721	☐ Anza Borrego 722	☐ Imperial 723	

Please provide the hydrologic sub-area and number(s)

Number	Name
905.21	SAN DIEGUITO HA, HODGES HA, DEL DIOS HSA

Please provide the beneficial uses for Inland Surface Waters and Ground Waters. Beneficial Uses can be obtained from the Water Quality Control Plan for the San Diego Basin, which is available at the Regional Board office or at http://www.waterboards.ca.gov/sandiego/water_issues/programs/basin_plan/index.shtml

SURFACE WATERS	Hydrologic Unit Basin Number	MUN	AGR	IND	PROC	GWR	FRESH	POW	REC1	REC2	BIOL	WARM	COLD	WILD	RARE	SPWN
Inland Surface Waters																
SN DIEGUITO RVR	905.21	X	X	X	X				X	X	X	X	X	X	X	
LAKE HODGES	905.21	X	X	X	X				X	X		X	X	X	X	
Ground Waters																
N/A																

*** Excepted from Municipal**

X Existing Beneficial Use
0 Potential Beneficial Use

POLLUTANTS OF CONCERN

Using Table 4, identify pollutants that are anticipated to be generated from the proposed priority project categories. Pollutants associated with any hazardous material sites that have been remediated or are not threatened by the proposed project are not considered a pollutant of concern.

Table 4. Anticipated and Potential Pollutants Generated by Land Use Type

	General Pollutant Categories								
PDP Categories	Sediments	Nutrients	Heavy Metals	Organic Compounds	Trash & Debris	Oxygen Demanding Substances	Oil & Grease	Bacteria & Viruses	Pesticides
Detached Residential Development	X	X			X	X	X	X	X
Attached Residential Development	X	X			X	P(1)	P(2)	P	X
Commercial Development 1 acre or greater	P(1)	P(1)		P(2)	X	P(5)	X	P(3)	P(5)
Heavy industry /industrial development	X		X	X	X	X	X		
Automotive Repair Shops			X	X(4)(5)	X		X		
Restaurants					X	X	X	X	
Hillside Development >5,000 ft^2	X	X			X	X	X		X
Parking Lots	P(1)	P(1)	X		X	P(1)	X		P(1)
Retail Gasoline Outlets			X	X	X	X	X		
Streets, Highways & Freeways	X	P(1)	X	X(4)	X	P(5)	X		

X = anticipated
P = potential
(1) A potential pollutant if landscaping exists on-site.
(2) A potential pollutant if the project includes uncovered parking areas.
(3) A potential pollutant if land use involves food or animal waste products.
(4) Including petroleum hydrocarbons.
(5) Including solvents.

Note: If other monitoring data that is relevant to the project is available. Please include as Attachment C.

CONSTRUCTION BMPs

Please check the construction BMPs that may be implemented during construction of the project. The applicant will be responsible for the placement and maintenance of the BMPs incorporated into the final project design.

- [X] Silt Fence
- [X] Fiber Rolls
- [X] Street Sweeping and Vacuuming
- [ ] Storm Drain Inlet Protection
- [X] Stockpile Management
- [X] Solid Waste Management
- [X] Stabilized Construction Entrance/Exit
- [ ] Dewatering Operations
- [ ] Vehicle and Equipment Maintenance
- [ ] Desilting Basin
- [X] Gravel Bag Berm
- [ ] Sandbag Barrier
- [X] Material Delivery and Storage
- [X] Spill Prevention and Control
- [X] Concrete Waste Management
- [X] Water Conservation Practices
- [X] Paving and Grinding Operations
- [X] Any minor slopes created incidental to construction and not subject to a major or minor grading permit shall be protected by covering with plastic or tarp prior to a rain event, and shall have vegetative cover reestablished within 180 days of completion of the slope and prior to final building approval.

EXCEPTIONAL THREAT TO WATER QUALITY DETERMINATION

Complete the checklist below to determine if a proposed project will pose an "exceptional threat to water quality," and therefore require Advanced Treatment Best Management Practices.

Table 5

No.	CRITERIA	YES	NO	INFORMATION
1.	Is all or part of the proposed project site within 200 feet of waters named on the Clean Water Act (CWA) Section 303(d) list of Water Quality Limited Segments as impaired for sedimentation and/or turbidity? Current 303d list may be obtained from the following site: http://www.swrcb.ca.gov/tmdl/docs/303dlists2006/approved/r9_06_303d_reqtmdls.pdf		X	If YES, continue to 2. If NO, go to 5.
2.	Will the project disturb more than 5 acres, including all phases of the development?			If YES, continue to 3. If NO, go to 5.
3.	Will the project disturb slopes that are steeper than 4:1 (horizontal: vertical) with at least 10 feet of relief, and that drain toward the 303(d) listed receiving water for sedimentation and/or turbidity?			If YES, continue to 4. If NO, go to 5.
4.	Will the project disturb soils with a predominance of USDA-NRCS Erosion factors k_f greater than or equal to 0.4?			If YES, continue to 6. If NO, go to 5.
5.	Project is not required to use Advanced Treatment BMPs.			Document for Project Files by referencing this checklist.
6.	Project poses an "exceptional threat to water quality" and is required to use Advanced Treatment BMPs.			Advanced Treatment BMPs must be consistent with WPO section 67.811(b)(20)(D) performance criteria

Exemption potentially available for projects that require advanced treatment:
Project proponent may perform a Revised Universal Soil Loss Equation, Version 2 (RUSLE 2), Modified Universal Soil Loss Equation (MUSLE), or similar analysis that shows to the County official's satisfaction that advanced treatment is not required

Now that the need for treatment BMPs has been determined, other information is needed to complete the SWMP.

SITE DESIGN

To minimize stormwater impacts, site design measures must be addressed. The following checklist provides options for avoiding or reducing potential impacts during project planning. If YES is checked, it is assumed that the measure was used for this project.

Table 6

	OPTIONS		YES	NO	N/A
1.	Has the project been located and road improvements aligned to avoid or minimize impacts to receiving waters or to increase the preservation of critical (or problematic) areas such as floodplains, steep slopes, wetlands, and areas with erosive or unstable soil conditions?		X		
2.	Is the project designed to minimize impervious footprint?		X		
3.	Is the project conserving natural areas where feasible?		X		
4.	Where landscape is proposed, are rooftops, impervious sidewalks, walkways, trails and patios be drained into adjacent landscaping?		X		
5.	For roadway projects, are structures and bridges be designed or located to reduce work in live streams and minimize construction impacts?				X
6.	Can any of the following methods be utilized to minimize erosion from slopes:				
	6.a.	Disturbing existing slopes only when necessary?	X		
	6.b.	Minimize cut and fill areas to reduce slope lengths?	X		
	6.c.	Incorporating retaining walls to reduce steepness of slopes or to shorten slopes?	X		
	6.d.	Providing benches or terraces on high cut and fill slopes to reduce concentration of flows?			X
	6.e.	Rounding and shaping slopes to reduce concentrated flow?	X		
	6.f.	Collecting concentrated flows in stabilized drains and channels?	X		

LOW IMPACT DEVELOPMENT (LID)

Each numbered item below is a LID requirement of the WPO. Please check the box(s) under each number that best describes the Low Impact Development BMP(s) selected for this project.

Table 7

1. Conserve natural Areas, Soils, and Vegetation-County LID Handbook 2.2.1
☐ Preserve well draining soils (Type A or B)
☐ Preserve Significant Trees
☒ Other. Description: PLEASE SEE ATTACHMENT I - ADDENDUM
☐ 1. Not feasible. State Reason:
2. Minimize Disturbance to Natural Drainages-County LID Handbook 2.2.2
☒ Set-back development envelope from drainages
☒ Restrict heavy construction equipment access to planned green/open space areas
☐ Other. Description:
☐ 2. Not feasible. State Reason:
3. Minimize and Disconnect Impervious Surfaces (see 5) -County LID Handbook 2.2.3
☐ Clustered Lot Design
☐ Items checked in 5?
☒ Other. Description: PLEASE SEE ATTACHMENT I - ADDENDUM
☐ 3. Not feasible. State Reason:
4. Minimize Soil Compaction-County LID Handbook 2.2.4
☒ Restrict heavy construction equipment access to planned green/open space areas
☒ Re-till soils compacted by construction vehicles/equipment
Collect & re-use upper soil layers of development site containing organic materials
☐ Other. Description:
4. Not feasible. State Reason:
5. Drain Runoff from Impervious Surfaces to Pervious Areas-County LID Handbook 2.2.5

LID Street & Road Design	
☐	Curb-cuts to landscaping
☒	Rural Swales PER LID FS-7 AND LID FS-18
☐	Concave Median
☐	Cul-de-sac Landscaping Design
☐	Other. Description:
LID Parking Lot Design	
☐	Permeable Pavements
☐	Curb-cuts to landscaping
☒	Other. Description: NOT APPLICABLE, NO PARKING LOTS
LID Driveway, Sidewalk, Bike-path Design	
☐	Permeable Pavements
☒	Pitch pavements toward landscaping PER LID FS-24
☐	Other. Description:
LID Building Design	
☐	Cisterns & Rain Barrels
☒	Downspout to swale PER CASQA SD-11
☐	Vegetated Roofs
☐	Other. Description:
LID Landscaping Design	
☐	Soil Amendments
☒	Reuse of Native Soils PER CASQA SD-10
☒	Smart Irrigation Systems PER CASQA SD-12
☐	Street Trees
☐	Other. Description:
☐ 5. Not feasible. State Reason:	

CHANNELS & DRAINAGES

Complete the following checklist to determine if the project includes work in channels.

Table 8

No.	CRITERIA	YES	NO	N/A	COMMENTS
1.	Will the project include work in channels?		X		If YES go to 2 If NO go to 13.
2.	Will the project increase velocity or volume of downstream flow?				If YES go to 6.
3.	Will the project discharge to unlined channels?				If YES go to. 6.
4.	Will the project increase potential sediment load of downstream flow?				If YES go to 6.
5.	Will the project encroach, cross, realign, or cause other hydraulic changes to a stream that may affect downstream channel stability?				If YES go to 8.
6.	Review channel lining materials and design for stream bank erosion.				Continue to 7.
7.	Consider channel erosion control measures within the project limits as well as downstream. Consider scour velocity.				Continue to 8.
8.	Include, where appropriate, energy dissipation devices at culverts.				Continue to 9.
9.	Ensure all transitions between culvert outlets/headwalls/wingwalls and channels are smooth to reduce turbulence and scour.				Continue to 10.
10.	Include, if appropriate, detention facilities to reduce peak discharges.				Continue to 11.
11.	"Hardening" natural downstream areas to prevent erosion is not an acceptable technique for protecting channel slopes, unless pre-development conditions are determined to be so erosive that hardening would be required even in the absence of the proposed development.				Continue to 12.
12.	Provide other design principles that are comparable and equally effective.				Continue to 13.
13.	End				

SOURCE CONTROL

Please complete the following checklist for Source Control BMPs. If the BMP is not applicable for this project, then check N/A only at the main category.

Table 9

BMP			YES	NO	N/A
1.	**Provide Storm Drain System Stenciling and Signage**				X
	1.a.	All storm drain inlets and catch basins within the project area shall have a stencil or tile placed with prohibitive language (such as: "NO DUMPING – DRAINS TO _____") and/or graphical icons to discourage illegal dumping.			
	1.b.	Signs and prohibitive language and/or graphical icons, which prohibit illegal dumping, must be posted at public access points along channels and creeks within the project area.			
2.	**Design Outdoors Material Storage Areas to Reduce Pollution Introduction**				X
	2.a.	This is a detached single-family residential project. Therefore, personal storage areas are exempt from this requirement.			
	2.b.	Hazardous materials with the potential to contaminate urban runoff shall either be: (1) placed in an enclosure such as, but not limited to, a cabinet, shed, or similar structure that prevents contact with runoff or spillage to the storm water conveyance system; or (2) protected by secondary containment structures such as berms, dikes, or curbs.			
	2.c.	The storage area shall be paved and sufficiently impervious to contain leaks and spills.			
	2.d.	The storage area shall have a roof or awning to minimize direct precipitation within the secondary containment area.			
3.	**Design Trash Storage Areas to Reduce Pollution Introduction**				X
	3.a.	Paved with an impervious surface, designed not to allow run-on from adjoining areas, screened or walled to prevent off-site transport of trash; or,			
	3.b.	Provide attached lids on all trash containers that exclude rain, or roof or awning to minimize direct precipitation.			
4.	**Use Efficient Irrigation Systems & Landscape Design**				
	The following methods to reduce excessive irrigation runoff shall be considered, and incorporated and implemented where determined applicable and feasible.				
	4.a.	Employing rain shutoff devices to prevent irrigation after precipitation.	X		
	4.b.	Designing irrigation systems to each landscape area's specific water requirements.	X		
	4.c.	Using flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.	X		
	4.d.	Employing other comparable, equally effective, methods to reduce irrigation water runoff.			X
5.	**Private Roads**				X

	BMP		YES	NO	N/A
	The design of private roadway drainage shall use at least one of the following				
	5.a.	Rural swale system: street sheet flows to vegetated swale or gravel shoulder, curbs at street corners, culverts under driveways and street crossings.			
	5.b.	Urban curb/swale system: street slopes to curb, periodic swale inlets drain to vegetated swale/biofilter.			
	5.c.	Dual drainage system: First flush captured in street catch basins and discharged to adjacent vegetated swale or gravel shoulder, high flows connect directly to storm water conveyance system.			
	5.d.	Other methods that are comparable and equally effective within the project.			
6.	**Residential Driveways & Guest Parking**				
	The design of driveways and private residential parking areas shall use one at least of the following features.				
	6.a.	Design driveways with shared access, flared (single lane at street) or wheelstrips (paving only under tires); or, drain into landscaping prior to discharging to the storm water conveyance system.	X		
	6.b.	Uncovered temporary or guest parking on private residential lots may be: paved with a permeable surface; or, designed to drain into landscaping prior to discharging to the storm water conveyance system.			X
	6.c.	Other features which are comparable and equally effective.			X
7.	**Dock Areas**				X
	Loading/unloading dock areas shall include the following.				
	7.a.	Cover loading dock areas, or design drainage to preclude urban run-on and runoff.			
	7.b.	Direct connections to storm drains from depressed loading docks (truck wells) are prohibited.			
	7.c.	Other features which are comparable and equally effective.			
8.	**Maintenance Bays**				X
	Maintenance bays shall include the following.				
	8.a.	Repair/maintenance bays shall be indoors; or, designed to preclude urban run-on and runoff.			
	8.b.	Design a repair/maintenance bay drainage system to capture all wash water, leaks and spills. Connect drains to a sump for collection and disposal. Direct connection of the repair/maintenance bays to the storm drain system is prohibited. If required by local jurisdiction, obtain an Industrial Waste Discharge Permit.			
	8.c.	Other features which are comparable and equally effective.			
9.	**Vehicle Wash Areas**				X
	Priority projects that include areas for washing/steam cleaning of vehicles shall use the following.				
	9.a.	Self-contained; or covered with a roof or overhang.			
	9.b.	Equipped with a clarifier or other pretreatment facility.			
	9.c.	Properly connected to a sanitary sewer.			
	9.d.	Other features which are comparable and equally effective.			

BMP			YES	NO	N/A
10.	**Outdoor Processing Areas**				X
	Outdoor process equipment operations, such as rock grinding or crushing, painting or coating, grinding or sanding, degreasing or parts cleaning, waste piles, and wastewater and solid waste treatment and disposal, and other operations determined to be a potential threat to water quality by the County shall adhere to the following requirements.				
	10.a.	Cover or enclose areas that would be the most significant source of pollutants; or, slope the area toward a dead-end sump; or, discharge to the sanitary sewer system following appropriate treatment in accordance with conditions established by the applicable sewer agency.			
	10.b.	Grade or berm area to prevent run-on from surrounding areas.			
	10.c.	Installation of storm drains in areas of equipment repair is prohibited.			
	10.d.	Other features which are comparable or equally effective.			
11.	**Equipment Wash Areas**				X
	Outdoor equipment/accessory washing and steam cleaning activities shall be.				
	11.a.	Be self-contained; or covered with a roof or overhang.			
	11.b.	Be equipped with a clarifier, grease trap or other pretreatment facility, as appropriate			
	11.c.	Be properly connected to a sanitary sewer.			
	11.d.	Other features which are comparable or equally effective.			
12.	**Parking Areas**				X
	The following design concepts shall be considered, and incorporated and implemented where determined applicable and feasible by the County.				
	12.a.	Where landscaping is proposed in parking areas, incorporate landscape areas into the drainage design.			
	12.b.	Overflow parking (parking stalls provided in excess of the County's minimum parking requirements) may be constructed with permeable paving.			
	12.c.	Other design concepts that are comparable and equally effective.			
13.	**Fueling Area**				X
	Non-retail fuel dispensing areas shall contain the following.				
	13.a.	Overhanging roof structure or canopy. The cover's minimum dimensions must be equal to or greater than the area within the grade break. The cover must not drain onto the fuel dispensing area and the downspouts must be routed to prevent drainage across the fueling area. The fueling area shall drain to the project's treatment control BMP(s) prior to discharging to the storm water conveyance system.			
	13.b.	Paved with Portland cement concrete (or equivalent smooth impervious surface). The use of asphalt concrete shall be prohibited.			
	13.c.	Have an appropriate slope to prevent ponding, and must be separated from the rest of the site by a grade break that prevents run-on of urban runoff.			

BMP			YES	NO	N/A
	13.d.	At a minimum, the concrete fuel dispensing area must extend 6.5 feet (2.0 meters) from the corner of each fuel dispenser, or the length at which the hose and nozzle assembly may be operated plus 1 foot (0.3 meter), whichever is less.			

Please list other project specific Source Control BMPs in the following box. Write **N/A** if there are none.

N/A

TREATMENT CONTROL

To select a structural treatment BMP using Treatment Control BMP Selection Matrix (Table 10), each priority project shall compare the list of pollutants for which the downstream receiving waters are impaired (if any), with the pollutants anticipated to be generated by the project (as identified in Table 4). Any pollutants identified by Table 4, which are also causing a Clean Water Act section 303(d) impairment of the receiving waters of the project, shall be considered primary pollutants of concern. Priority projects that are anticipated to generate a primary pollutant of concern shall select a single or combination of stormwater BMPs from Table 10, which **maximizes pollutant removal** for the particular primary pollutant(s) of concern.

Priority development projects that are **not** anticipated to generate a pollutant for which the receiving water is CWA 303(d) impaired shall select a single or combination of stormwater BMPs from Table 10, which are effective for pollutant removal of the identified secondary pollutants of concern, consistent with the "maximum extent practicable" standard.

Table 10. Treatment Control BMP Selection Matrix

Pollutants of Concern	Bioretention Facilities (LID)*	Settling Basins (Dry Ponds)	Wet Ponds and Wetlands	Infiltration Facilities or Practices (LID)*	Media Filters	High-rate biofilters	High-rate media filters	Trash Racks & Hydro -dynamic Devices
Coarse Sediment and Trash	High	High	High	High	High	High	High	High
Pollutants that tend to associate with fine particles during treatment	High	High	High	High	High	Medium	Medium	Low
Pollutants that tend to be dissolved following treatment	Medium	Low	Medium	High	Low	Low	Low	Low

*Additional information is available in the County of San Diego LID Handbook.

NOTES ON POLLUTANTS OF CONCERN:
In Table 11, Pollutants of Concern are grouped as gross pollutants, pollutants that tend to associate with fine particles, and pollutants that remain dissolved.

Table 11

Pollutant	Coarse Sediment and Trash	Pollutants that tend to associate with fine particles during treatment	Pollutants that tend to be dissolved following treatment
Sediment	X	X	
Nutrients		X	X
Heavy Metals		X	
Organic Compounds		X	
Trash & Debris	X		
Oxygen Demanding		X	
Bacteria		X	
Oil & Grease		X	
Pesticides		X	

A Treatment BMP must address runoff from developed areas. Please provide the post-construction water quality treatment volume or flow values for the selected project Treatment BMP(s). Guidelines for design calculations are located in Chapter 5, Section 4.3, Principle 8 of the County SUSMP. Label outfalls on the BMP map. The Water Quality peak rate of discharge flow (Q_{WQ}) and the Water Quality storage volume (V_{WQ}) is dependent on the type of treatment BMP selected for the project.

Outfall	Tributary Area (acres)	Q_{WQ} (cfs)	V_{WQ} (ft^3)
A	0.12	0.009	N/A
B	0.21	0.015	N/A
C	0.41	0.030	N/A
D	0.41	0.030	N/A
E	0.25	0.043	N/A
F	0.25	0.018	N/A

*ADDITIONAL INFORMATION PROVIDED FOR REFERENCE IN ATTACHMENT E.

Please check the box(s) that best describes the Treatment BMP(s) selected for this project.

Biofilters
X Bioretention swale
☐ Vegetated filter strip
☐ Stormwater Planter Box (open-bottomed)
☐ Stormwater Flow-Through Planter (sealed bottom)
☐ Bioretention Area
☐ Vegetated Roofs/Modules/Walls
Detention Basins
☐ Extended/dry detention basin with grass/vegetated lining
☐ Extended/dry detention basin with impervious lining
Infiltration Basins
☐ Infiltration basin
☐ Infiltration trench
☐ Dry well
☐ Permeable Paving
☐ Gravel
☐ Permeable asphalt
☐ Pervious concrete
☐ Unit pavers, ungrouted, set on sand or gravel
☐ Subsurface reservoir bed
Wet Ponds or Wetlands
☐ Wet pond/basin (permanent pool)
☐ Constructed wetland
Filtration
☐ Media filtration
☐ Sand filtration
Hydrodynamic Separator Systems
☐ Swirl Concentrator
☐ Cyclone Separator
Trash Racks and Screens

Include Treatment Datasheet as Attachment E. The datasheet should include the following:	**COMPLETED**	**NO**
1. Description of how treatment BMP was designed. Provide a description for each type of treatment BMP.	X	
2. Engineering calculations for the BMP(s)	X	

Please describe why the selected treatment BMP(s) was selected for this project. For projects utilizing a low performing BMP, please provide a detailed explanation.

PLEASE REFER TO SECTION 5.0 OF ATTACHMENT I - SWMP ADDENDUM FOR THE PROJECT'S SWMP CONCLUSION.

MAINTENANCE

Please check the box that best describes the maintenance mechanism(s) for this project. Guidelines for each category are located in Chapter 5, Section 5.2 of the County SUSMP.

CATEGORY	SELECTED	
	YES	NO
First	X	
Second[1]		
Third[1]		
Fourth		

Note:
1. Projects in Category 2 or 3 may choose to establish or be included in a Stormwater Maintenance Assessment District for the long-term maintenance of treatment BMPs.

ATTACHMENTS

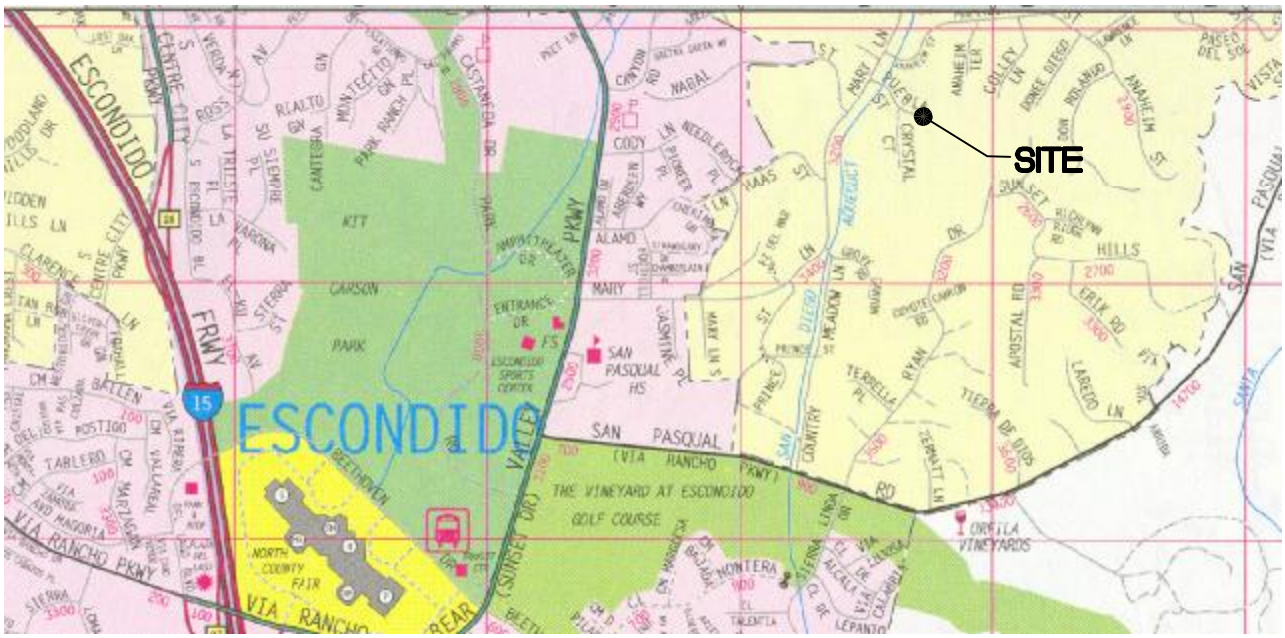
Please include the following attachments.

ATTACHMENT		COMPLETED	N/A
A	Project Location Map	X	
B	Site Map	X	
C	Relevant Monitoring Data	X	X
D	LID and Treatment BMP Location Map	X	
E	Treatment BMP Datasheets	X	
F	Operation and Maintenance Program for Treatment BMPs	X	
G	Fiscal Resources	X	
H	Certification Sheet	X	
I	Addendum	X	

Note: Attachments A and B may be combined.

ATTACHMENT A+B: PROJECT LOCATION MAP

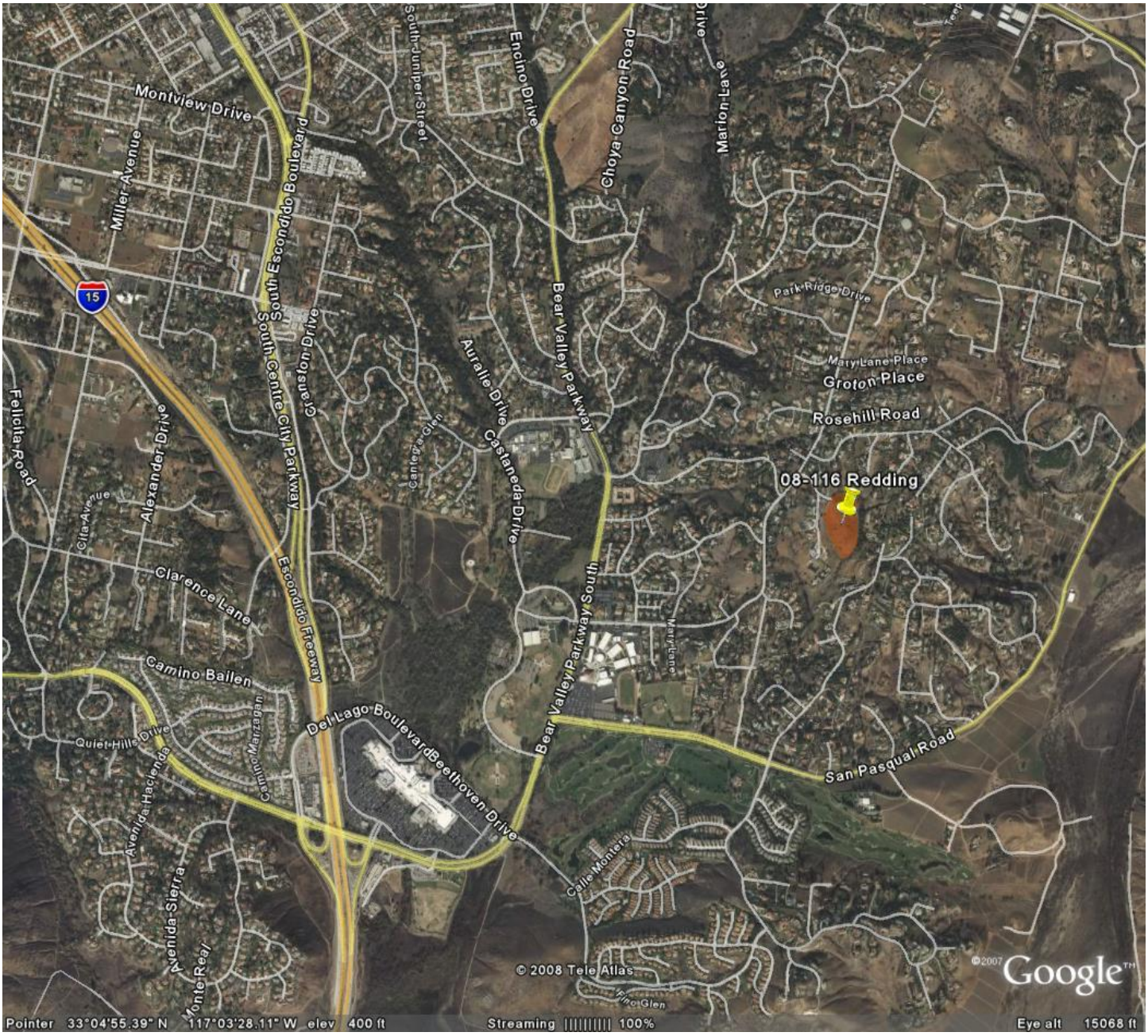
Please see the attached exhibits.



VICINITY MAP

N.T.S.

T.B. PAGE 1150
GRID: D–1



GOOGLE EARTH VICINITY MAP

N.T.S.

ATTACHMENT C: RELEVANT MONITORING DATA

There is no relevant monitoring data for the project site at this time.

ATTACHMENT D: LID AND TREATMENT CONTROL BMP LOCATION MAP

Please see the attached map.

SWMP - MAJOR BMP LOCATION MAP FOR REDDING MINOR SUBDIVISION (TPM 21112)

CASQA BMP REFERENCE NOTE:

ALL CASQA BMP FACT SHEETS REFERENCED ON THIS PLAN ARE FROM THE CASQA NEW DEVELOPMENT BMP HANDBOOK. COPIES OF THE REFERENCED BMP FACT SHEETS CAN BE FOUND BY VISITING THE FOLLOWING WEB SITE:

COUNTY LID FACT SHEET NOTE:

ALL COUNTY OF SAN DIEGO LID FACT SHEETS CAN BE FOUND IN THE COUNTY OF SAN DIEGO LOW IMPACT DEVELOPMENT HANDBOOK (JULY 20, 2007 DRAFT EDITION). THIS MANUAL CAN BE OBTAINED FROM THE COUNTY OF SAN DIEGO.

ⓘ RIP RAP DATA TABLE

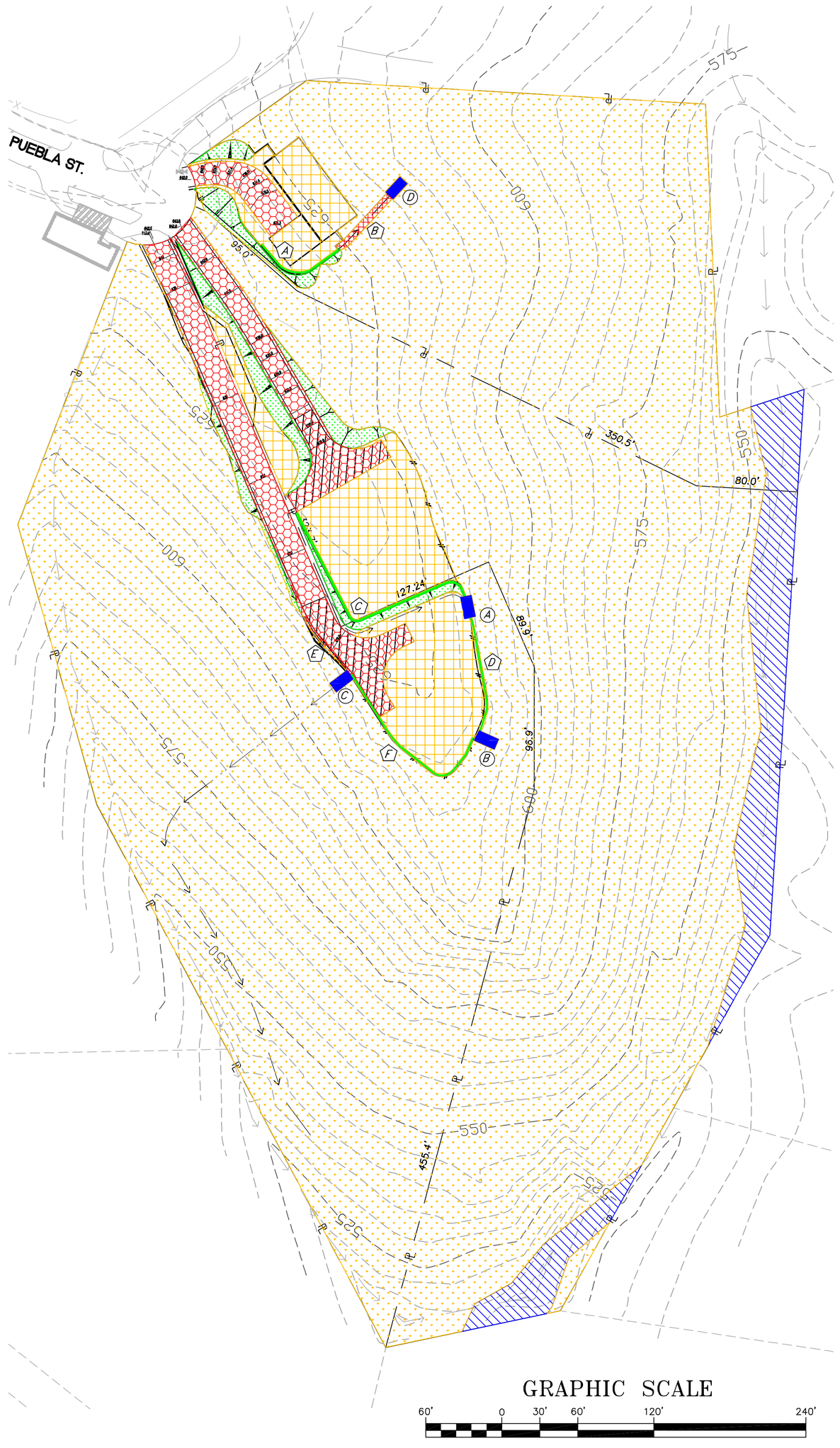
No.	LENGTH	WIDTH	ROCK	THICKNESS	TYPE	Q100 (CFS)	V100 (FPS)
A	10'	5'	#2 BACKING	1.1'	TYPE 1	0.82	1.2
B	10'	5'	#2 BACKING	1.1'	TYPE 1	0.82	2.7
C	10'	5'	#2 BACKING	1.1'	TYPE 1	1.36	5.2
D	10'	5'	#2 BACKING	1.1'	TYPE 1	0.56	2.9

RIP RAP NOTE:

ALL RIP RAP ENERGY DISSIPATERS ARE PER SDRSD D-40. RIP RAP ENERGY DISSIPATOR CALCULATIONS ARE PROVIDED IN THE PROJECT'S HYDROLOGY STUDY PERFORMED BY WYNN ENGINEERING INC.

ⓘ SWALE BMP DATA TABLE

No.	TYPE	LENGTH (FEET)	WIDTH (FEET)	DEPTH (IN)	SIDE SLOPES	SLOPE	n	Q-100 (CFS)	Q-WQ (CFS)	CONTACT TIME (MIN)	WATER DEPTH (IN)	DETAIL SECTION
A	VEGETATED	100	2	4	3:1 MIN.	2.5%	0.025	0.45	0.009	1.93	0.7	B-B
B	ROCK	60	2	12	1:1	20%	0.037	0.56	0.015	N/A	1.1	A-A
C	VEGETATED	350	2	4	3:1 MIN.	1%	0.025	0.82	0.030	7.05	1.3	B-B
D	VEGETATED	100	3	6	3:1 MIN.	0.9%	0.025	0.82	0.030	2.09	1.3	C-C
E	ROCK	275	2	12	1:1	4.7%	0.037	1.36	0.043	N/A	2.1	A-A
F	VEGETATED	110	2	4	3:1 MIN.	1%	0.025	0.47	0.018	2.52	1.1	B-B



GRAPHIC SCALE

60' 0 30' 60' 120' 240'

1 inch = 60' ft.

VICINITY MAP
N.T.S.

T.B. PAGE 1150
GRID: D-1

HYDROLOGIC BASIN INFORMATION:

BASIN NUMBER: 905.21

HYDROLOGIC UNIT: SAN DIEGUITO

HYDROLOGIC AREA: HODGES HA

HYDROLOGIC SUB-AREA: DEL DIOS HSA

RECEIVING WATERS: LAKE HODGES

BASIN BENEFICIAL USES:

INLAND WATERS	RESERVOIS/LAKES
MUN	MUN
AGR	AGR
IND	IND
PROC	PROC
REC-1	REC-1
REC-2	REC-2
BIOL	WARM
WARM	COLD
COLD	WILD
WILD	RARE
RARE	

BASIN 303(d) INFORMATION:

RECEIVING WATERS: 905.21

POLLUTANTS/STRESSORS:
- COLOR
- MANGANESE
- NITROGEN
- pH
- PHOSPHORUS
- TURBIDITY

POLLUTANTS OF CONCERN:

THE FOLLOWING ARE ANTICIPATED POLLUTANTS OF CONCERN FOR THE PROJECT SITE:
- SEDIMENT
- NUTRIENTS
- TRASH & DEBRIS
- OXYGEN DEMANING SUBSTANCES
- OIL & GREASE
- PESTICIDES

THERE ARE NO POTENTIAL POLLUTANTS OF CONCERN FOR THE PROJECT SITE.

LID AND SITE DESIGN BMP LEGEND

LID & SITE DESIGN BMP	FACT SHEET	SYMBOL
MINIMIZE AND DISCONNECT IMPERVIOUS SURFACES	CASQA SD-10	
CONSERVE NATURAL AREAS, SOILS, AND VEGETATION	CASQA SD-10	
CONVEY RUNOFF SAFELY FROM TOPS OF SLOPES	LID FS 4	
VEGETATE SLOPES WITH NATIVE OR DROUGHT TOLERANT VEGETATION	CASQA SD-10	
ROCK SWALES	LID FS 4	
INSTALL RIP RAP ENERGY DISSIPATORS	SDRSD D-40	

SOURCE CONTROL BMP LEGEND

SOURCE CONTROL BMP	FACT SHEET	SYMBOL
USE EFFICIENT IRRIGATION SYSTEMS AND LANDSCAPE DESIGN	CASQA SD-10, SD-12	NON-PLOTTABLE

TREATMENT CONTROL BMP LEGEND

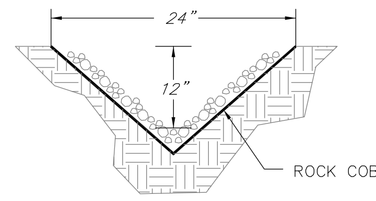
TREATMENT CONTROL BMP	FACT SHEET	SYMBOL
VEGETATED SWALES	CASQA TC-30, LID FS-4, LID FS-7 LID FS-18	

MISC. BMP LEGEND

BMP	FACT SHEET	SYMBOL
ROOF RUNOFF CONTROLS	CASQA SD-11	NON-PLOTTABLE
LID DRIVEWAY, SIDEWALK, AND BIKE PATH DESIGN	LID FS-24	

MISC. ITEMS

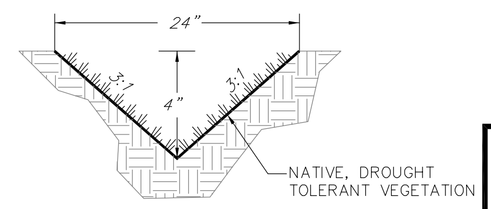
BMP	SYMBOL
100-YEAR INUNDATION AREA FROM PRELIMINARY HYDROLOGY STUDY	



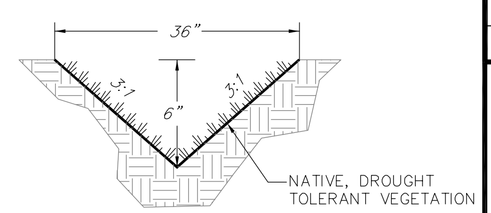
ROCK COBBLE NOTE:

ROCK COBBLES TO CONFORM TO A MINIMUM ROCK GRADATION OF #2 BACKING PER TABLE 5-3 OF THE C.O.S.D. DRAINAGE DESIGN MANUAL

SECTION A-A: ROCK LINED DRAINAGE SWALE
N.T.S.



SECTION B-B: VEGETATED SWALE
N.T.S.



SECTION C-C: VEGETATED SWALE
N.T.S.

REGISTERED PROFESSIONAL ENGINEER
GARY R. WYNN
No. C 43202
EXP. 3-31-10
CIVIL
STATE OF CALIFORNIA

WYNN ENGINEERING, INC.
27315 VALLEY CENTER ROAD
VALLEY CENTER, CA. 92082
(760) 749-8722 (310) 306-9728
FAX (760) 749-9412

WEI JOB NO. 08-116	3/11/09	B-239

PRIVATE CONTRACT

COUNTY OF SAN DIEGO
DEPARTMENT OF PLANNING AND LAND USE

SWMP MAJOR - BMP EXHIBIT FOR:

REDDING MINOR SUBDIVISION
TPM 21112

SHEET: 1 OF SHEETS: 1

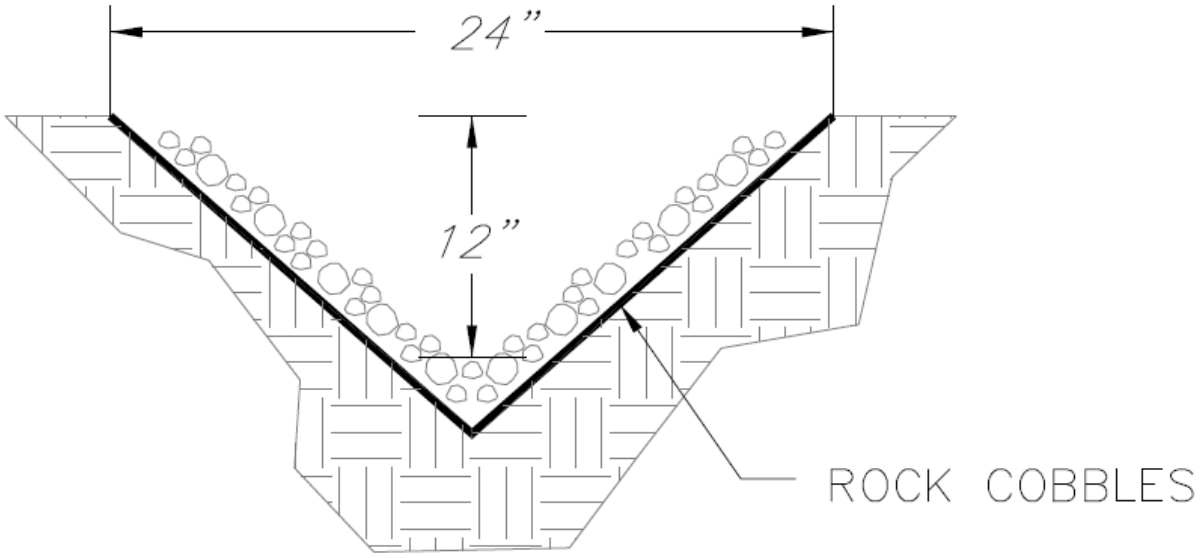
Date Plotted : Mar 11, 2009 - 2:06pm
Plotted By : ROBERT
F:\2008\08-116 REDDING\DWG\ 08-116 SWMP-MAJOR REVISION 1 3-10-09.DWG
SWMP MAJOR - BMP MAP

ATTACHMENT E: TREATMENT BMP DATA

This attachment contains Treatment BMP Data associated with the water quality treatment control and/or conveyance components of the Stormwater Management Plan. The following are AutoCAD calculation output summaries based on the Proposed Conditions Calculations found in the project' Preliminary Hydrology Study Attachment 3.

CHANNEL SECTIONS

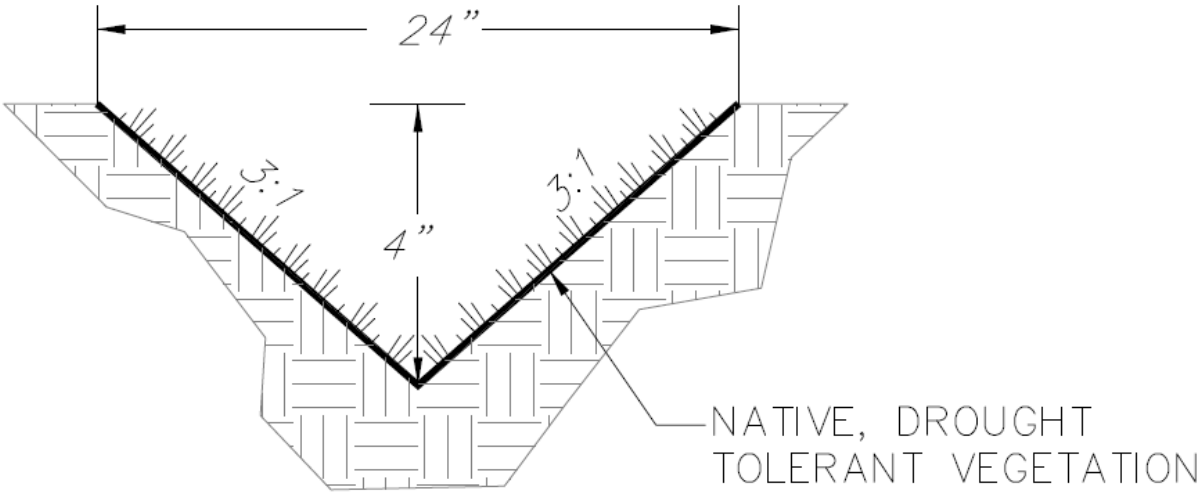
There are three different channel configurations that will be used on the project site. There are two vegetated swale and one rock line swale configurations. The sections of each are as follows:



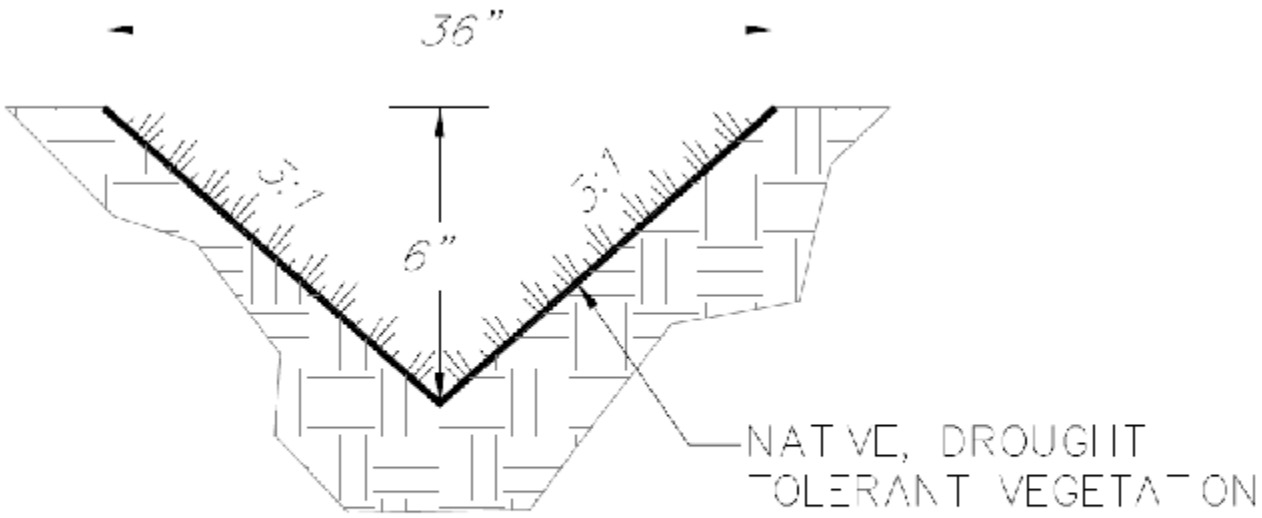
ROCK COBBLE NOTE:

ROCK COBBLES TO CONFORM TO A MINIMUM ROCK GRADATION OF #2 BACKING PER TABLE 5-3 OF THE C.O.S.D. DRAINAGE DESIGN MANUAL

SECTION A-A: ROCK LINED DRAINAGE SWALE
N.T.S.



SECTION B–B: VEGETATED SWALE
N.T.S.



SECTION C–C: VEGETATED SWALE
N.T.S.

SWMP – MAJOR
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA

CHANNEL A – VEGETATED SWALE

Q_{WC} Water Quality Discharge (85^{th} Percentile)

Q_{WC} = (C) x (I_{85th}) x (A)
= 0.36 x 0.20 x 0.12
= 0.009 cfs

Base Channel Information from AutoCAD Software:

Channel Calculator

Given Input Data:
- Shape ..... Trapezoidal
- Solving for ..... Depth of Flow
- Flowrate ..... 0.0090 cfs
- Slope ..... 0.0250 ft/ft
- Manning's n 0.0250
- Height ..... 4.0000 in
- Bottom width ..... 0.0000 in
- Left slope ..... 0.3300 ft/ft (V/H)
- Right slope ..... 0.3300 ft/ft (V/H)

Computed Results:
- Depth ..... 0.7038 in
- Velocity ..... 0.8635 fps
- Full Flowrate ..... 0.9259 cfs
- Flow area 0.0104 ft2
- Flow perimeter ..... 4.4916 in
- Hydraulic radius ..... 0.3342 in
- Top width ..... 4.2654 in
- Area 0.3367 ft2
- Perimeter ..... 25.5283 in
- Percent full ..... 17.5947 %

Critical Information
- Critical depth ..... 0.6714 in
- Critical slope ..... 0.0321 ft/ft
- Critical velocity ..... 0.9487 fps
- Critical area 0.0095 ft2
- Critical perimeter ..... 4.2850 in
- Critical hydraulic radius ..... 0.3188 in
- Critical top width ..... 4.0692 in
- Specific energy ..... 0.0702 ft
- Minimum energy ..... 0.0839 ft
- Froude number 0.8889
- Flow condition ..... Subcritical

Residence Time: = Length of Swale / Velocity of Swale
= 100 feet / 0.8635 fps
= 115.81 sec
= 1.93 minutes

SWMP – MAJOR
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA

CHANNEL B – ROCK SWALE (#2 BACKING)

Q_{WC} Water Quality Discharge (85^{th} Percentile)

Q_{WC} = (C) x (I_{85th}) x (A)
= 0.36 x 0.20 x 0.21
= 0.015 cfs

Base Channel Information from AutoCAD Software:

Channel Calculator

Given Input Data:
- Shape ..... Trapezoidal
- Solving for ..... Depth of Flow
- Flowrate ..... 0.0150 cfs
- Slope ..... 0.2000 ft/ft
- Manning's n 0.0370
- Height ..... 12.0000 in
- Bottom width ..... 0.0000 in
- Left slope ..... 1.0000 ft/ft (V/H)
- Right slope ..... 1.0000 ft/ft (V/H)

Computed Results:
- Depth ..... 1.0908 in
- Velocity ..... 1.8155 fps
- Full Flowrate ..... 8.9805 cfs
- Flow area 0.0083 ft2
- Flow perimeter ..... 3.0851 in
- Hydraulic radius ..... 0.3856 in
- Top width ..... 2.1815 in
- Area 1.0000 ft2
- Perimeter ..... 33.9411 in
- Percent full ..... 9.0896 %

Critical Information
- Critical depth ..... 1.2833 in
- Critical slope ..... 0.0840 ft/ft
- Critical velocity ..... 1.3116 fps
- Critical area 0.0114 ft2
- Critical perimeter ..... 3.6297 in
- Critical hydraulic radius ..... 0.4537 in
- Critical top width ..... 2.5666 in
- Specific energy ..... 0.1421 ft
- Minimum energy ..... 0.1604 ft
- Froude number 1.5014
- Flow condition ..... Supercritical

Residence Time: = Length of Swale / Velocity of Swale
= 60 feet / 1.8155 fps
= 33.05 sec
= 0.56 minutes*

* This swale is a Rock Lined Channel; therefore, residence time does not matter

SWMP – MAJOR
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA

CHANNEL C – VEGETATED SWALE

Q_{WC} Water Quality Discharge (85^{th} Percentile)

Q_{WC} = (C) x (I_{85th}) x (A)
= 0.36 x 0.20 x 0.41
= 0.030 cfs

Base Channel Information from AutoCAD Software:

Channel Calculator

Given Input Data:
Shape ..... Trapezoidal
Solving for ..... Depth of Flow
Flowrate ..... 0.0300 cfs
Slope ..... 0.0100 ft/ft
Manning's n 0.0250
Height ..... 4.0000 in
Bottom width ..... 0.0000 in
Left slope ..... 0.3300 ft/ft (V/H)
Right slope ..... 0.3300 ft/ft (V/H)

Computed Results:
Depth ..... 1.3126 in
Velocity ..... 0.8274 fps
Full Flowrate ..... 0.5856 cfs
Flow area 0.0363 ft2
Flow perimeter ..... 8.3771 in
Hydraulic radius ..... 0.6232 in
Top width ..... 7.9552 in
Area 0.3367 ft2
Perimeter ..... 25.5283 in
Percent full ..... 32.8151 %

Critical Information
Critical depth ..... 1.0868 in
Critical slope ..... 0.0274 ft/ft
Critical velocity ..... 1.2070 fps
Critical area 0.0249 ft2
Critical perimeter ..... 6.9359 in
Critical hydraulic radius ..... 0.5160 in
Critical top width ..... 6.5865 in
Specific energy ..... 0.1200 ft
Minimum energy ..... 0.1358 ft
Froude number 0.6238
Flow condition ..... Subcritical

Residence Time: = Length of Swale / Velocity of Swale
= 350 feet / 0.8274 fps
= 423.01 sec
= 7.05 minutes

SWMP – MAJOR
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA

CHANNEL D – VEGETATED SWALE

Q_{WC} Water Quality Discharge (85th Percentile)

Q_{WC} = (C) x (I_{85th}) x (A)
= 0.36 x 0.20 x 0.41
= 0.030 cfs

Base Channel Information from AutoCAD Software:

Channel Calculator

Given Input Data:
Shape ..... Trapezoidal
Solving for ..... Depth of Flow
Flowrate ..... 0.0300 cfs
Slope ..... 0.0090 ft/ft
Manning's n 0.0250
Height ..... 6.0000 in
Bottom width ..... 0.0000 in
Left slope ..... 0.3300 ft/ft (V/H)
Right slope ..... 0.3300 ft/ft (V/H)

Computed Results:
Depth ..... 1.3388 in
Velocity ..... 0.7954 fps
Full Flowrate ..... 1.6379 cfs
Flow area 0.0377 ft2
Flow perimeter ..... 8.5443 in
Hydraulic radius ..... 0.6357 in
Top width ..... 8.1139 in
Area 0.7576 ft2
Perimeter ..... 38.2925 in
Percent full ..... 22.3132 %

Critical Information
Critical depth ..... 1.0868 in
Critical slope ..... 0.0274 ft/ft
Critical velocity ..... 1.2070 fps
Critical area 0.0249 ft2
Critical perimeter ..... 6.9359 in
Critical hydraulic radius ..... 0.5160 in
Critical top width ..... 6.5865 in
Specific energy ..... 0.1214 ft
Minimum energy ..... 0.1358 ft
Froude number 0.5937
Flow condition ..... Subcritical

Residence Time: = Length of Swale / Velocity of Swale
= 100 feet / 0.7954 fps
= 125.72 sec
= 2.09 minutes

SWMP – MAJOR
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA

CHANNEL E – ROCK SWALE (#2 BACKING)

Q_{WC} Water Quality Discharge (85th Percentile)

Q_{WC} = (C) x (I_{85th}) x (A)
= 0.36 x 0.20 x 0.59
= 0.043 cfs

Base Channel Information from AutoCAD Software:

Channel Calculator

Given Input Data:
- Shape ..... Trapezoidal
- Solving for ..... Depth of Flow
- Flowrate ..... 0.0430 cfs
- Slope ..... 0.0470 ft/ft
- Manning's n 0.0370
- Height ..... 12.0000 in
- Bottom width ..... 0.0000 in
- Left slope ..... 1.0000 ft/ft (V/H)
- Right slope ..... 1.0000 ft/ft (V/H)

Computed Results:
- Depth ..... 2.1241 in
- Velocity ..... 1.3724 fps
- Full Flowrate ..... 4.3535 cfs
- Flow area 0.0313 ft2
- Flow perimeter ..... 6.0078 in
- Hydraulic radius ..... 0.7510 in
- Top width ..... 4.2481 in
- Area 1.0000 ft2
- Perimeter ..... 33.9411 in
- Percent full ..... 17.7006 %

Critical Information
- Critical depth ..... 1.9556 in
- Critical slope ..... 0.0730 ft/ft
- Critical velocity ..... 1.6191 fps
- Critical area 0.0266 ft2
- Critical perimeter ..... 5.5312 in
- Critical hydraulic radius ..... 0.6914 in
- Critical top width ..... 3.9111 in
- Specific energy ..... 0.2063 ft
- Minimum energy ..... 0.2444 ft
- Froude number 0.8133
- Flow condition ..... Subcritical

Residence Time: = Length of Swale / Velocity of Swale
= 275 feet / 1.3724 fps
= 200.38 sec
= 3.34 minutes*

* This swale is a Rock Lined Channel; therefore, residence time does not matter

SWMP – MAJOR
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA

CHANNEL F – VEGETATED SWALE

Q_{WC} Water Quality Discharge (85th Percentile)

Q_{WC} = (C) x (I_{85th}) x (A)
= 0.36 x 0.20 x 0.25
= 0.018 cfs

Base Channel Information from AutoCAD Software:

Channel Calculator

Given Input Data:
Shape ..... Trapezoidal
Solving for ..... Depth of Flow
Flowrate ..... 0.0180 cfs
Slope ..... 0.0100 ft/ft
Manning's n 0.0250
Height ..... 4.0000 in
Bottom width ..... 0.0000 in
Left slope ..... 0.3300 ft/ft (V/H)
Right slope ..... 0.3300 ft/ft (V/H)

Computed Results:
Depth ..... 1.0838 in
Velocity ..... 0.7282 fps
Full Flowrate ..... 0.5856 cfs
Flow area 0.0247 ft2
Flow perimeter ..... 6.9168 in
Hydraulic radius ..... 0.5146 in
Top width ..... 6.5684 in
Area 0.3367 ft2
Perimeter ..... 25.5283 in
Percent full ..... 27.0945 %

Critical Information
Critical depth ..... 0.8859 in
Critical slope ..... 0.0293 ft/ft
Critical velocity ..... 1.0898 fps
Critical area 0.0165 ft2
Critical perimeter ..... 5.6541 in
Critical hydraulic radius ..... 0.4207 in
Critical top width ..... 5.3693 in
Specific energy ..... 0.0986 ft
Minimum energy ..... 0.1107 ft
Froude number 0.6042
Flow condition ..... Subcritical

Residence Time: = Length of Swale / Velocity of Swale
= 110 feet / 0.7282 fps
= 151.06 sec
= 2.52 minutes

BMP FACT SHEETS

Various best management practice (BMP) fact sheets are attached here for reference in regards to this project. The following are attached here for reference:

California Stormwater Quality Association BMP Fact Sheets:
- SD-10: Site Design & Landscape Planning
- SD-11: Roof Run-off Controls
- SD-12: Efficient Irrigation
- TC-30: Vegetated Swales

County of San Diego LID Handbook Fact Sheets
- LID FS-4: Vegetated Swales
- LID FS-7: Bioretention Systems
- LID FS-18: Rural Swale System
- LID FS-24: LID Driveway, Sidewalk, and Bike Path Design

San Diego Regional Standard Drawings:
- D-40: Rip Rap Energy Dissipater

Site Design & Landscape Planning SD-10

Design Objectives

- ✓ Maximize Infiltration
- ✓ Provide Retention
- ✓ Slow Runoff
- ✓ Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Each project site possesses unique topographic, hydrologic, and vegetative features, some of which are more suitable for development than others. Integrating and incorporating appropriate landscape planning methodologies into the project design is the most effective action that can be done to minimize surface and groundwater contamination from stormwater.

Approach

Landscape planning should couple consideration of land suitability for urban uses with consideration of community goals and projected growth. Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Design requirements for site design and landscapes planning should conform to applicable standards and specifications of agencies with jurisdiction and be consistent with applicable General Plan and Local Area Plan policies.

Designing New Installations

Begin the development of a plan for the landscape unit with attention to the following general principles:

- Formulate the plan on the basis of clearly articulated community goals. Carefully identify conflicts and choices between retaining and protecting desired resources and community growth.

- Map and assess land suitability for urban uses. Include the following landscape features in the assessment: wooded land, open unwooded land, steep slopes, erosion-prone soils, foundation suitability, soil suitability for waste disposal, aquifers, aquifer recharge areas, wetlands, floodplains, surface waters, agricultural lands, and various categories of urban land use. When appropriate, the assessment can highlight outstanding local or regional resources that the community determines should be protected (e.g., a scenic area, recreational area, threatened species habitat, farmland, fish run). Mapping and assessment should recognize not only these resources but also additional areas needed for their sustenance.

Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Conserve Natural Areas during Landscape Planning

If applicable, the following items are required and must be implemented in the site layout during the subdivision design and approval process, consistent with applicable General Plan and Local Area Plan policies:

- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.

- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.

- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.

- Promote natural vegetation by using parking lot islands and other landscaped areas.

- Preserve riparian areas and wetlands.

Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit

- Promote the conservation of forest cover. Building on land that is already deforested affects basin hydrology to a lesser extent than converting forested land. Loss of forest cover reduces interception storage, detention in the organic forest floor layer, and water losses by evapotranspiration, resulting in large peak runoff increases and either their negative effects or the expense of countering them with structural solutions.

- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and

regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.

- Evaluating infiltration opportunities by referring to the stormwater management manual for the jurisdiction and pay particular attention to the selection criteria for avoiding groundwater contamination, poor soils, and hydrogeological conditions that cause these facilities to fail. If necessary, locate developments with large amounts of impervious surfaces or a potential to produce relatively contaminated runoff away from groundwater recharge areas.

Protection of Slopes and Channels during Landscape Design

- Convey runoff safely from the tops of slopes.
- Avoid disturbing steep or unstable slopes.
- Avoid disturbing natural channels.
- Stabilize disturbed slopes as quickly as possible.
- Vegetate slopes with native or drought tolerant vegetation.
- Control and treat flows in landscaping and/or other controls prior to reaching existing natural drainage systems.
- Stabilize temporary and permanent channel crossings as quickly as possible, and ensure that increases in run-off velocity and frequency caused by the project do not erode the channel.
- Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters shall be installed in such a way as to minimize impacts to receiving waters.
- Line on-site conveyance channels where appropriate, to reduce erosion caused by increased flow velocity due to increases in tributary impervious area. The first choice for linings should be grass or some other vegetative surface, since these materials not only reduce runoff velocities, but also provide water quality benefits from filtration and infiltration. If velocities in the channel are high enough to erode grass or other vegetative linings, riprap, concrete, soil cement, or geo-grid stabilization are other alternatives.
- Consider other design principles that are comparable and equally effective.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define “redevelopment” in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of “ redevelopment” must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under “designing new installations” above should be followed.

SD-10 Site Design & Landscape Planning

Redevelopment may present significant opportunity to add features which had not previously been implemented. Examples include incorporation of depressions, areas of permeable soils, and swales in newly redeveloped areas. While some site constraints may exist due to the status of already existing infrastructure, opportunities should not be missed to maximize infiltration, slow runoff, reduce impervious areas, disconnect directly connected impervious areas.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Stormwater Management Manual for Western Washington, Washington State Department of Ecology, August 2001.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Roof Runoff Controls SD-11

Rain Garden

Design Objectives

- ✓ Maximize Infiltration
- ✓ Provide Retention
- ✓ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ✓ Contain Pollutants
- Collect and Convey

Description

Various roof runoff controls are available to address stormwater that drains off rooftops. The objective is to reduce the total volume and rate of runoff from individual lots, and retain the pollutants on site that may be picked up from roofing materials and atmospheric deposition. Roof runoff controls consist of directing the roof runoff away from paved areas and mitigating flow to the storm drain system through one of several general approaches: cisterns or rain barrels; dry wells or infiltration trenches; pop-up emitters, and foundation planting. The first three approaches require the roof runoff to be contained in a gutter and downspout system. Foundation planting provides a vegetated strip under the drip line of the roof.

Approach

Design of individual lots for single-family homes as well as lots for higher density residential and commercial structures should consider site design provisions for containing and infiltrating roof runoff or directing roof runoff to vegetative swales or buffer areas. Retained water can be reused for watering gardens, lawns, and trees. Benefits to the environment include reduced demand for potable water used for irrigation, improved stormwater quality, increased groundwater recharge, decreased runoff volume and peak flows, and decreased flooding potential.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Designing New Installations

Cisterns or Rain Barrels

One method of addressing roof runoff is to direct roof downspouts to cisterns or rain barrels. A cistern is an above ground storage vessel with either a manually operated valve or a permanently open outlet. Roof runoff is temporarily stored and then released for irrigation or infiltration between storms. The number of rain

barrels needed is a function of the rooftop area. Some low impact developers recommend that every house have at least 2 rain barrels, with a minimum storage capacity of 1000 liters. Roof barrels serve several purposes including mitigating the first flush from the roof which has a high volume, amount of contaminants, and thermal load. Several types of rain barrels are commercially available. Consideration must be given to selecting rain barrels that are vector proof and childproof. In addition, some barrels are designed with a bypass valve that filters out grit and other contaminants and routes overflow to a soak-away pit or rain garden.

If the cistern has an operable valve, the valve can be closed to store stormwater for irrigation or infiltration between storms. This system requires continual monitoring by the resident or grounds crews, but provides greater flexibility in water storage and metering. If a cistern is provided with an operable valve and water is stored inside for long periods, the cistern must be covered to prevent mosquitoes from breeding.

A cistern system with a permanently open outlet can also provide for metering stormwater runoff. If the cistern outlet is significantly smaller than the size of the downspout inlet (say ¼ to ½ inch diameter), runoff will build up inside the cistern during storms, and will empty out slowly after peak intensities subside. This is a feasible way to mitigate the peak flow increases caused by rooftop impervious land coverage, especially for the frequent, small storms.

Dry wells and Infiltration Trenches

Roof downspouts can be directed to dry wells or infiltration trenches. A dry well is constructed by excavating a hole in the ground and filling it with an open graded aggregate, and allowing the water to fill the dry well and infiltrate after the storm event. An underground connection from the downspout conveys water into the dry well, allowing it to be stored in the voids. To minimize sedimentation from lateral soil movement, the sides and top of the stone storage matrix can be wrapped in a permeable filter fabric, though the bottom may remain open. A perforated observation pipe can be inserted vertically into the dry well to allow for inspection and maintenance.

In practice, dry wells receiving runoff from single roof downspouts have been successful over long periods because they contain very little sediment. They must be sized according to the amount of rooftop runoff received, but are typically 4 to 5 feet square, and 2 to 3 feet deep, with a minimum of 1-foot soil cover over the top (maximum depth of 10 feet).

To protect the foundation, dry wells must be set away from the building at least 10 feet. They must be installed in solids that accommodate infiltration. In poorly drained soils, dry wells have very limited feasibility.

Infiltration trenches function in a similar manner and would be particularly effective for larger roof areas. An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives stormwater runoff. These are described under Treatment Controls.

Pop-up Drainage Emitter

Roof downspouts can be directed to an underground pipe that daylights some distance from the building foundation, releasing the roof runoff through a pop-up emitter. Similar to a pop-up irrigation head, the emitter only opens when there is flow from the roof. The emitter remains flush to the ground during dry periods, for ease of lawn or landscape maintenance.

Foundation Planting

Landscape planting can be provided around the base to allow increased opportunities for stormwater infiltration and protect the soil from erosion caused by concentrated sheet flow coming off the roof. Foundation plantings can reduce the physical impact of water on the soil and provide a subsurface matrix of roots that encourage infiltration. These plantings must be sturdy enough to tolerate the heavy runoff sheet flows, and periodic soil saturation.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Supplemental Information

Examples

- City of Ottawa's Water Links Surface –Water Quality Protection Program
- City of Toronto Downspout Disconnection Program
- City of Boston, MA, Rain Barrel Demonstration Program

Other Resources

Hager, Marty Catherine, Stormwater, "Low-Impact Development", January/February 2003. www.stormh2o.com

Low Impact Urban Design Tools, Low Impact Development Design Center, Beltsville, MD. www.lid-stormwater.net

Start at the Source, Bay Area Stormwater Management Agencies Association, 1999 Edition

Efficient Irrigation SD-12

Design Objectives

- ✓ Maximize Infiltration
- ✓ Provide Retention
- ✓ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Irrigation water provided to landscaped areas may result in excess irrigation water being conveyed into stormwater drainage systems.

Approach

Project plan designs for development and redevelopment should include application methods of irrigation water that minimize runoff of excess irrigation water into the stormwater conveyance system.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Designing New Installations

The following methods to reduce excessive irrigation runoff should be considered, and incorporated and implemented where determined applicable and feasible by the Permittee:

- Employ rain-triggered shutoff devices to prevent irrigation after precipitation.
- Design irrigation systems to each landscape area's specific water requirements.
- Include design featuring flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
- Implement landscape plans consistent with County or City water conservation resolutions, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.

- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.
- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider design features such as:
  - Using mulches (such as wood chips or bar) in planter areas without ground cover to minimize sediment in runoff
  - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect
  - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible
  - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth
- Employ other comparable, equally effective methods to reduce irrigation water runoff.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Vegetated Swale TC-30

Design Considerations

- Tributary Area
- Area Required
- Slope
- Water Availability

Description

Vegetated swales are open, shallow channels with vegetation covering the side slopes and bottom that collect and slowly convey runoff flow to downstream discharge points. They are designed to treat runoff through filtering by the vegetation in the channel, filtering through a subsoil matrix, and/or infiltration into the underlying soils. Swales can be natural or manmade. They trap particulate pollutants (suspended solids and trace metals), promote infiltration, and reduce the flow velocity of stormwater runoff. Vegetated swales can serve as part of a stormwater drainage system and can replace curbs, gutters and storm sewer systems.

Targeted Constituents

✓	Sediment	▲
✓	Nutrients	●
✓	Trash	●
✓	Metals	▲
✓	Bacteria	●
✓	Oil and Grease	▲
✓	Organics	▲

Legend ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

California Experience

Caltrans constructed and monitored six vegetated swales in southern California. These swales were generally effective in reducing the volume and mass of pollutants in runoff. Even in the areas where the annual rainfall was only about 10 inches/yr, the vegetation did not require additional irrigation. One factor that strongly affected performance was the presence of large numbers of gophers at most of the sites. The gophers created earthen mounds, destroyed vegetation, and generally reduced the effectiveness of the controls for TSS reduction.

Advantages

- If properly designed, vegetated, and operated, swales can serve as an aesthetic, potentially inexpensive urban development or roadway drainage conveyance measure with significant collateral water quality benefits.

CASQA California Stormwater Quality Association

- Roadside ditches should be regarded as significant potential swale/buffer strip sites and should be utilized for this purpose whenever possible.

Limitations

- Can be difficult to avoid channelization.
- May not be appropriate for industrial sites or locations where spills may occur
- Grassed swales cannot treat a very large drainage area. Large areas may be divided and treated using multiple swales.
- A thick vegetative cover is needed for these practices to function properly.
- They are impractical in areas with steep topography.
- They are not effective and may even erode when flow velocities are high, if the grass cover is not properly maintained.
- In some places, their use is restricted by law: many local municipalities require curb and gutter systems in residential areas.
- Swales are mores susceptible to failure if not properly maintained than other treatment BMPs.

Design and Sizing Guidelines

- Flow rate based design determined by local requirements or sized so that 85% of the annual runoff volume is discharged at less than the design rainfall intensity.
- Swale should be designed so that the water level does not exceed 2/3rds the height of the grass or 4 inches, which ever is less, at the design treatment rate.
- Longitudinal slopes should not exceed 2.5%
- Trapezoidal channels are normally recommended but other configurations, such as parabolic, can also provide substantial water quality improvement and may be easier to mow than designs with sharp breaks in slope.
- Swales constructed in cut are preferred, or in fill areas that are far enough from an adjacent slope to minimize the potential for gopher damage. Do not use side slopes constructed of fill, which are prone to structural damage by gophers and other burrowing animals.
- A diverse selection of low growing, plants that thrive under the specific site, climatic, and watering conditions should be specified. Vegetation whose growing season corresponds to the wet season are preferred. Drought tolerant vegetation should be considered especially for swales that are not part of a regularly irrigated landscaped area.
- The width of the swale should be determined using Manning's Equation using a value of 0.25 for Manning's n.

Construction/Inspection Considerations

- Include directions in the specifications for use of appropriate fertilizer and soil amendments based on soil properties determined through testing and compared to the needs of the vegetation requirements.
- Install swales at the time of the year when there is a reasonable chance of successful establishment without irrigation; however, it is recognized that rainfall in a given year may not be sufficient and temporary irrigation may be used.
- If sod tiles must be used, they should be placed so that there are no gaps between the tiles; stagger the ends of the tiles to prevent the formation of channels along the swale or strip.
- Use a roller on the sod to ensure that no air pockets form between the sod and the soil.
- Where seeds are used, erosion controls will be necessary to protect seeds for at least 75 days after the first rainfall of the season.

Performance

The literature suggests that vegetated swales represent a practical and potentially effective technique for controlling urban runoff quality. While limited quantitative performance data exists for vegetated swales, it is known that check dams, slight slopes, permeable soils, dense grass cover, increased contact time, and small storm events all contribute to successful pollutant removal by the swale system. Factors decreasing the effectiveness of swales include compacted soils, short runoff contact time, large storm events, frozen ground, short grass heights, steep slopes, and high runoff velocities and discharge rates.

Conventional vegetated swale designs have achieved mixed results in removing particulate pollutants. A study performed by the Nationwide Urban Runoff Program (NURP) monitored three grass swales in the Washington, D.C., area and found no significant improvement in urban runoff quality for the pollutants analyzed. However, the weak performance of these swales was attributed to the high flow velocities in the swales, soil compaction, steep slopes, and short grass height.

Another project in Durham, NC, monitored the performance of a carefully designed artificial swale that received runoff from a commercial parking lot. The project tracked 11 storms and concluded that particulate concentrations of heavy metals (Cu, Pb, Zn, and Cd) were reduced by approximately 50 percent. However, the swale proved largely ineffective for removing soluble nutrients.

The effectiveness of vegetated swales can be enhanced by adding check dams at approximately 17 meter (50 foot) increments along their length (See Figure 1). These dams maximize the retention time within the swale, decrease flow velocities, and promote particulate settling. Finally, the incorporation of vegetated filter strips parallel to the top of the channel banks can help to treat sheet flows entering the swale.

Only 9 studies have been conducted on all grassed channels designed for water quality (Table 1). The data suggest relatively high removal rates for some pollutants, but negative removals for some bacteria, and fair performance for phosphorus.

Table 1 Grassed swale pollutant removal efficiency data							
	Removal Efficiencies (% Removal)						
Study	TSS	TP	TN	NO_3	Metals	Bacteria	Type
Caltrans 2002	77	8	67	66	83-90	-33	dry swales
Goldberg 1993	67.8	4.5	-	31.4	42–62	-100	grassed channel
Seattle Metro and Washington Department of Ecology 1992	60	45	-	-25	2–16	-25	grassed channel
Seattle Metro and Washington Department of Ecology, 1992	83	29	-	-25	46–73	-25	grassed channel
Wang et al., 1981	80	-	-	-	70–80	-	dry swale
Dorman et al., 1989	98	18	-	45	37–81	-	dry swale
Harper, 1988	87	83	84	80	88–90	-	dry swale
Kercher et al., 1983	99	99	99	99	99	-	dry swale
Harper, 1988.	81	17	40	52	37–69	-	wet swale
Koon, 1995	67	39	-	9	-35 to 6	-	wet swale

While it is difficult to distinguish between different designs based on the small amount of available data, grassed channels generally have poorer removal rates than wet and dry swales, although some swales appear to export soluble phosphorus (Harper, 1988; Koon, 1995). It is not clear why swales export bacteria. One explanation is that bacteria thrive in the warm swale soils.

Siting Criteria

The suitability of a swale at a site will depend on land use, size of the area serviced, soil type, slope, imperviousness of the contributing watershed, and dimensions and slope of the swale system (Schueler et al., 1992). In general, swales can be used to serve areas of less than 10 acres, with slopes no greater than 5 %. Use of natural topographic lows is encouraged and natural drainage courses should be regarded as significant local resources to be kept in use (Young et al., 1996).

Selection Criteria (NCTCOG, 1993)

- Comparable performance to wet basins
- Limited to treating a few acres
- Availability of water during dry periods to maintain vegetation
- Sufficient available land area

Research in the Austin area indicates that vegetated controls are effective at removing pollutants even when dormant. Therefore, irrigation is not required to maintain growth during dry periods, but may be necessary only to prevent the vegetation from dying.

The topography of the site should permit the design of a channel with appropriate slope and cross-sectional area. Site topography may also dictate a need for additional structural controls. Recommendations for longitudinal slopes range between 2 and 6 percent. Flatter slopes can be used, if sufficient to provide adequate conveyance. Steep slopes increase flow velocity, decrease detention time, and may require energy dissipating and grade check. Steep slopes also can be managed using a series of check dams to terrace the swale and reduce the slope to within acceptable limits. The use of check dams with swales also promotes infiltration.

Additional Design Guidelines

Most of the design guidelines adopted for swale design specify a minimum hydraulic residence time of 9 minutes. This criterion is based on the results of a single study conducted in Seattle, Washington (Seattle Metro and Washington Department of Ecology, 1992), and is not well supported. Analysis of the data collected in that study indicates that pollutant removal at a residence time of 5 minutes was not significantly different, although there is more variability in that data. Therefore, additional research in the design criteria for swales is needed. Substantial pollutant removal has also been observed for vegetated controls designed solely for conveyance (Barrett et al, 1998); consequently, some flexibility in the design is warranted.

Many design guidelines recommend that grass be frequently mowed to maintain dense coverage near the ground surface. Recent research (Colwell et al., 2000) has shown mowing frequency or grass height has little or no effect on pollutant removal.

Summary of Design Recommendations

1) The swale should have a length that provides a minimum hydraulic residence time of at least 10 minutes. The maximum bottom width should not exceed 10 feet unless a dividing berm is provided. The depth of flow should not exceed 2/3rds the height of the grass at the peak of the water quality design storm intensity. The channel slope should not exceed 2.5%.

2) A design grass height of 6 inches is recommended.

3) Regardless of the recommended detention time, the swale should be not less than 100 feet in length.

4) The width of the swale should be determined using Manning's Equation, at the peak of the design storm, using a Manning's n of 0.25.

5) The swale can be sized as both a treatment facility for the design storm and as a conveyance system to pass the peak hydraulic flows of the 100-year storm if it is located "on-line." The side slopes should be no steeper than 3:1 (H:V).

6) Roadside ditches should be regarded as significant potential swale/buffer strip sites and should be utilized for this purpose whenever possible. If flow is to be introduced through curb cuts, place pavement slightly above the elevation of the vegetated areas. Curb cuts should be at least 12 inches wide to prevent clogging.

7) Swales must be vegetated in order to provide adequate treatment of runoff. It is important to maximize water contact with vegetation and the soil surface. For general purposes, select fine, close-growing, water-resistant grasses. If possible, divert runoff (other than necessary irrigation) during the period of vegetation

establishment. Where runoff diversion is not possible, cover graded and seeded areas with suitable erosion control materials.

Maintenance

The useful life of a vegetated swale system is directly proportional to its maintenance frequency. If properly designed and regularly maintained, vegetated swales can last indefinitely. The maintenance objectives for vegetated swale systems include keeping up the hydraulic and removal efficiency of the channel and maintaining a dense, healthy grass cover.

Maintenance activities should include periodic mowing (with grass never cut shorter than the design flow depth), weed control, watering during drought conditions, reseeding of bare areas, and clearing of debris and blockages. Cuttings should be removed from the channel and disposed in a local composting facility. Accumulated sediment should also be removed manually to avoid concentrated flows in the swale. The application of fertilizers and pesticides should be minimal.

Another aspect of a good maintenance plan is repairing damaged areas within a channel. For example, if the channel develops ruts or holes, it should be repaired utilizing a suitable soil that is properly tamped and seeded. The grass cover should be thick; if it is not, reseed as necessary. Any standing water removed during the maintenance operation must be disposed to a sanitary sewer at an approved discharge location. Residuals (e.g., silt, grass cuttings) must be disposed in accordance with local or State requirements. Maintenance of grassed swales mostly involves maintenance of the grass or wetland plant cover. Typical maintenance activities are summarized below:

- Inspect swales at least twice annually for erosion, damage to vegetation, and sediment and debris accumulation preferably at the end of the wet season to schedule summer maintenance and before major fall runoff to be sure the swale is ready for winter. However, additional inspection after periods of heavy runoff is desirable. The swale should be checked for debris and litter, and areas of sediment accumulation.

- Grass height and mowing frequency may not have a large impact on pollutant removal. Consequently, mowing may only be necessary once or twice a year for safety or aesthetics or to suppress weeds and woody vegetation.

- Trash tends to accumulate in swale areas, particularly along highways. The need for litter removal is determined through periodic inspection, but litter should always be removed prior to mowing.

- Sediment accumulating near culverts and in channels should be removed when it builds up to 75 mm (3 in.) at any spot, or covers vegetation.

- Regularly inspect swales for pools of standing water. Swales can become a nuisance due to mosquito breeding in standing water if obstructions develop (e.g. debris accumulation, invasive vegetation) and/or if proper drainage slopes are not implemented and maintained.

Cost

Construction Cost

Little data is available to estimate the difference in cost between various swale designs. One study (SWRPC, 1991) estimated the construction cost of grassed channels at approximately $0.25 per ft^2. This price does not include design costs or contingencies. Brown and Schueler (1997) estimate these costs at approximately 32 percent of construction costs for most stormwater management practices. For swales, however, these costs would probably be significantly higher since the construction costs are so low compared with other practices. A more realistic estimate would be a total cost of approximately $0.50 per ft^2, which compares favorably with other stormwater management practices.

Table 2 Swale Cost Estimate (SEWRPC, 1991)

Component	Unit	Extent	Unit Cost			Total Cost		
			Low	Moderate	High	Low	Moderate	High
Mobilization / Demobilization-Light	Swale	1	$107	$274	$441	$107	$274	$441
Site Preparation								
Clearing[b]	Acre	0.5	$2,200	$3,800	$5,400	$1,100	$1,900	$2,700
Grubbing[c]	Acre	0.25	$3,800	$5,200	$6,600	$950	$1,300	$1,650
General Excavation[d]	Yd^3	372	$2.10	$3.70	$5.30	$781	$1,376	$1,972
Level and Till[e]	Yd^2	1,210	$0.20	$0.35	$0.50	$242	$424	$605
Sites Development								
Salvaged Topsoil Seed, and Mulch[f]	Yd^2	1,210	$0.40	$1.00	$1.60	$484	$1,210	$1,936
Sod[g]	Yd^2	1,210	$1.20	$2.40	$3.60	$1,452	$2,904	$4,356
Subtotal	--	–	--	–	--	$5,116	$9,388	$13,660
Contingencies	Swale	1	25%	25%	25%	$1,279	$2,347	$3,415
Total	--	–	--	–	--	$6,395	$11,735	$17,075

Source: (SEWRPC, 1991)

Note: Mobilization/demobilization refers to the organization and planning involved in establishing a vegetative swale.

[a] Swale has a bottom width of 1.0 foot, a top width of 10 feet with 1:3 side slopes, and a 1,000-foot length.

[b] Area cleared = (top width + 10 feet) x swale length.

[c] Area grubbed = (top width x swale length).

[d] Volume excavated = (0.67 x top width x swale depth) x swale length (parabolic cross-section).

[e] Area tilled = $\left(\text{top width} + \frac{8(\text{swale depth}^2)}{3(\text{top width})}\right) \times$ swale length (parabolic cross-section).

[f] Area seeded = area cleared x 0.5.

[g] Area sodded = area cleared x 0.5.

Table 3 Estimated Maintenance Costs (SEWRPC, 1991)

Component	Unit Cost	Swale Size (Depth and Top Width)		Comment
		1.5 Foot Depth, One-Foot Bottom Width, 10-Foot Top Width	3-Foot Depth, 3-Foot Bottom Width, 21-Foot Top Width	
Lawn Mowing	$0.85 / 1,000 ft^2/ mowing	$0.14 / linear foot	$0.21 / linear foot	Lawn maintenance area=(top width + 10 feet) x length. Mow eight times per year
General Lawn Care	$9.00 / 1,000 ft^2/ year	$0.18 / linear foot	$0.28 / linear foot	Lawn maintenance area = (top width + 10 feet) x length
Swale Debris and Litter Removal	$0.10 / linear foot / year	$0.10 / linear foot	$0.10 / linear foot	–
Grass Reseeding with Mulch and Fertilizer	$0.30 / yd^2	$0.01 / linear foot	$0.01 / linear foot	Area revegetated equals 1% of lawn maintenance area per year
Program Administration and Swale Inspection	$0.15 / linear foot / year, plus $25 / inspection	$0.15 / linear foot	$0.15 / linear foot	Inspect four times per year
Total	--	**$0.58 / linear foot**	**$ 0.75 / linear foot**	--

Maintenance Cost

Caltrans (2002) estimated the expected annual maintenance cost for a swale with a tributary area of approximately 2 ha at approximately $2,700. Since almost all maintenance consists of mowing, the cost is fundamentally a function of the mowing frequency. Unit costs developed by SEWRPC are shown in Table 3. In many cases vegetated channels would be used to convey runoff and would require periodic mowing as well, so there may be little additional cost for the water quality component. Since essentially all the activities are related to vegetation management, no special training is required for maintenance personnel.

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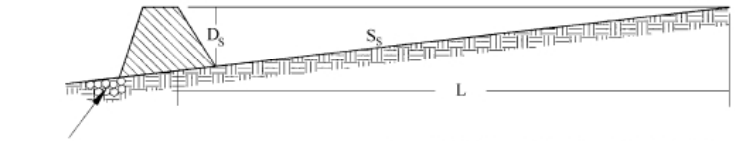
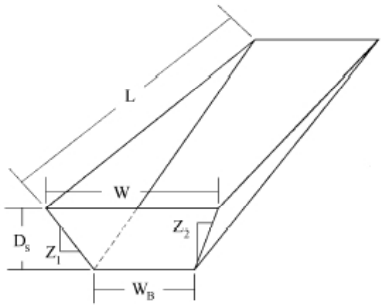


Provide for scour protection.

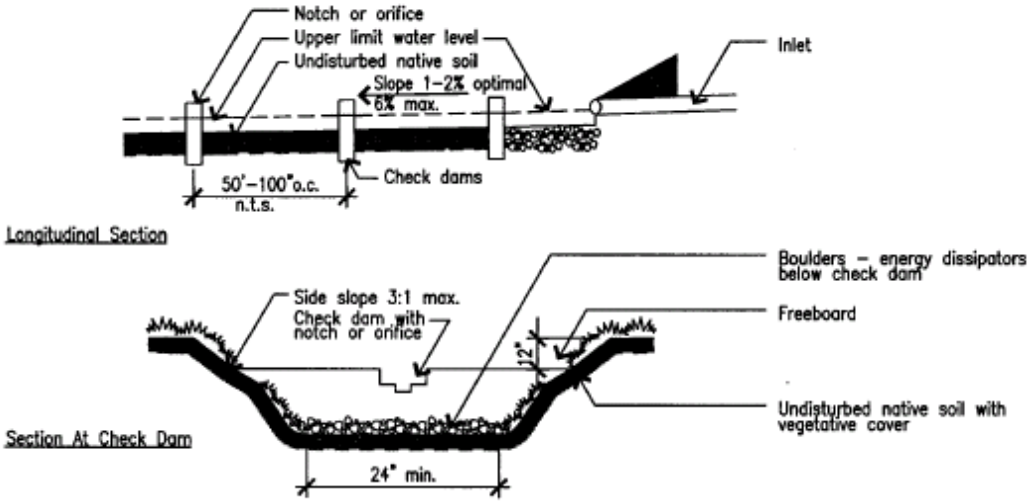
(a) Cross section of swale with check dam.



(b) Dimensional view of swale impoundment area.

Notation:
L = Length of swale impoundment area per check dam (ft)
D_S = Depth of check dam (ft)
S_S = Bottom slpe of swale (ft/ft)
W = Top width of check dam (ft)
W_B = Bottom width of check dam (ft)
$Z_{1\&2}$ = Ratio of horizontal to vertical change in swale side slope (ft/ft)

Fact Sheet 4. Vegetated Swale / Rock Swale



Conditions, dimensions, and materials shown are typical. Modifications may be required for proper application, consult qualified professional.

Vegetated / rock swales are vegetated or rock lined earthen channels that collect, convey, and filter site water runoff and remove pollutants. Swales are an alternative to lined channels and pipes; configuration and setting are unique to each site.

CHARACTERISTICS

- If properly designed and maintained, swales can last for at least 50 years.
- Can be used in all soil types, natural or amended.
- When swales are not holding water, they appear as a typical landscaped area.
- Water is filtered by vegetation/rocks and pollutants are removed by infiltration into the subsurface of the soil.
- Swales also serve to delay runoff peaks by reducing flow velocities.

APPLICATION

- Swales are most effective in removing coarse to medium sized sediments.
- Parking lot medians, perimeters of impervious pavements.
- Street and highway medians, edges (in lieu of curb and gutter, where appropriate).
- In combination with constructed treatment systems or sand filters.

DESIGN

- Vegetation of each swale is unique to the setting, function, climate, geology, and character of each site and climatic condition.
- Can be designed with natural or amended soils, depending on the infiltration rate provided by the natural condition versus the rate needed to reduce surface runoff .
- Grass swales move water more quickly than vegetated swales. A grass swale is planted with salt grass; a vegetated swale is planted with bunch grass, shrubs or trees.
- Rocks, gravel, boulders, and/or cobbles help slow peak velocity, allow sedimentation, and add aesthetic value.

- Pollutant removal effectiveness can be maximized by increasing residence time of water in swale using weirs or check dams.
- Swales are often used as an alternative to curbs and gutters along roadways, but can also be used to convey stormwater flows in recreation areas and parking lots.
- Calculations should also be provided proving the swale capable of safely conveying the 100-year flow to the swale without flooding adjacent property or infrastructure.
- See County of San Diego Drainage Design Manual for design criteria. (section 5.5) http://www.sdcounty.ca.gov/dpw/docs/hydrologymanual.pdf

MAINTENANCE

- Swale maintenance includes mowing and removing clippings and litter. Vegetated swales may require additional maintenance of plants.
- Periodically remove sediment accumulation at top of bank, in swale bed, or behind check dams.
- Monitor for erosion and reseed grass or replace plants, erosion control netting and mulch as necessary. Fertilize and replace vegetation well in advance of rainy season to minimize water quality degradation.
- Regular inspections and maintenance is required during the establishment period.

LIMITATIONS

- Only suitable for grades between 1% and 6%; when greater than 2.5% should be paired with weir or check dam.
- "Turf" swales will commonly require irrigation and may not meet State water conservation goals.
- Irrigated vegetation is not appropriate in certain sites. Xeriscape techniques, natural stone and rock linings should be used as an alternative to turf.
- Wider road corridors may be required to incorporate swales.
- Contributing drainage areas should be sized to meet the stormwater management objective given the amount of flow that will be produced.
- When contributing flow could cause formation of low-flow channel, channel dividers must be constructed to direct flow and prevent erosion.

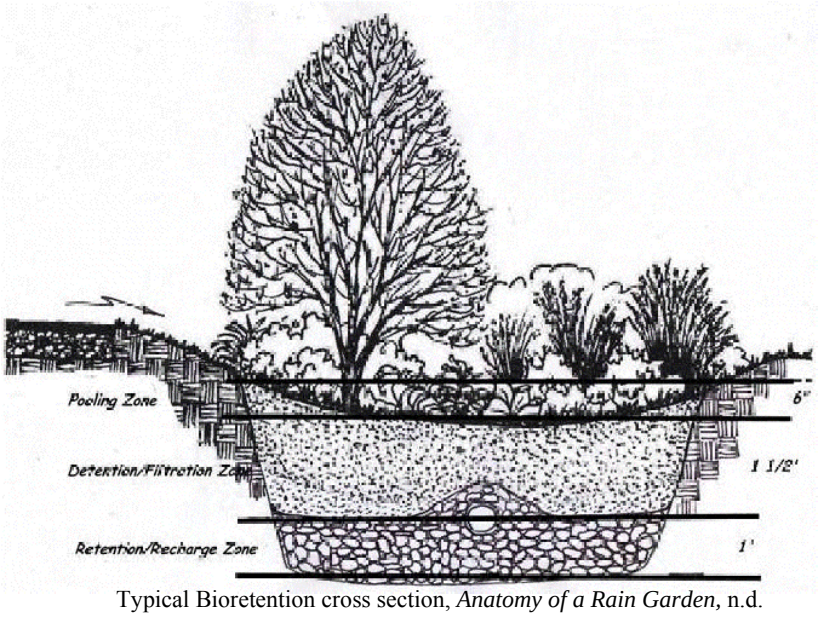
ECONOMICS

- Estimated grass swale construction cost per linear foot $4.50-$8.50 (from seed) to $15-20 (from sod), compare to $2 per inch of diameter underground pipe e.g., a 12" pipe would cost $24 per linear foot).
- $0.75 annual maintenance cost per linear foot

REFERENCES

- CALTRANS – Storm Water Handbook (cabmphandbooks.com)
- For additional information pertaining to Swales, see the works cited in the San Diego County LID Literature Index.

Fact Sheet 7. Bioretention Systems



Typical Bioretention cross section, *Anatomy of a Rain Garden,* n.d.

Bioretention systems are essentially a surface and sub-surface water filtration system. In function they are similar to sand filters. Bioretention systems incorporate both plants and underlying filter soils for removal of contaminants. These facilities normally consist of a treatment train approach: filter strip, sand bed, ponding area, organic layer, planting soil, and plants.

CHARACTERISICS

- Effective in removing sediments and attached pollutants by filtration through surface vegetation, ground cover and underlying filter media layer
- Delay runoff peaks by providing retention capacity and reducing flow velocities.
- Vegetation increases aesthetic value while also enhancing filtration capacity and helping to maintain the porosity of the filter media.
- Can be constructed as either large or small scale devices, with native or amended soils.
- Small scale units are usually located in a residential planter box that filters collected stormwater through the filter media and to an outlet.
- Larger scale devices work on the same methodology, however are generally located along the streetscapes and retarding basins over large open areas.
- In addition, there are two main types of bioretention system: Non-conveyance systems, which generally pond runoff volume, and Conveyance, which generally convey minor storm events along longitudinal channels. Such conveyance systems generally include an amended soil layer under the surface for additional storage and filtration

APPLICATION

- Effective in removing medium to fine size sediments and attached pollutants (such as nutrients, free oils/grease and metals), but typically have higher pollutant

removal efficiencies for a wider range of contaminants due to enhanced filtration/biological processes associated with the surface vegetation.
- Best suited to small residential, commercial, and industrial developments with high percentages of impervious areas, including parking lots, high density residential housing, and roadways.
- Aesthetic benefits due to the surface vegetation make bioretention systems appealing for incorporation into streetscape and general landscape features.

DESIGN
- Provide a gentle slope for overland flow and adequate water storage. No water should be allowed to pond in the bioretention system for longer than 72 hours.
- Usually designed in conjunction with swales and other devices upstream so as to reduce filter clogging and provide water treatment (treatment train).
- Filter media employed is usually the plant growing material, which may comprise soil, sand and peat mixtures.
- "Planting box" type systems should be restricted to very small catchment areas.
- A subdrain system should be included in urban areas along with associated cleanout to facilitate maintenance.
- For more precise design techniques, see: CASQA (2003, January) California Stormwater BMP Handbook: New Development and Redevelopment

MAINTENANCE
- Generally, only routine periodic maintenance typical of any landscaped area (mulching, plant replacement, pruning, weeding) is necessary.
- Regular inspections and maintenance are particularly important during the vegetation establishment period.
- Routine maintenance should include a biannual health evaluation of the trees and shrubs and subsequent removal of any dead or diseased vegetation.
- Other potential tasks include soil pH regulation, erosion repair at inflow points, mulch replenishment, unclogging the under-drain, and repairing overflow structures.

LIMITATIONS
- Adequate sunlight is required for vegetation growth.
- The use of irrigation may not meet State water conservation goals. Appropriate drought-tolerant plants should be considered.
- Placement may be limited by the need for upstream pre-treatment so as to avoid filter clogging (treatment train).
- Contributing drainage area should be less than 1 acre for small-scale, on-lot devices
- Bioretention (a BMP with incidental infiltration) is not an appropriate BMP when:
    - the seasonal high groundwater table is within 6 feet of the ground surface (US EPA 1999)
    - at locations where or where surrounding soil stratum is unstable
- exceptions to the 6 foot separation can be made when:
    - the BMP is designed with an under-drain and approved by a qualified licensed professional, or when:

  - written approval of a separation in the interval of 4-6 feet has been obtained by the Regional Water Quality Control Board and the Department of Environmental Health.
- Site must contain sufficient elevation relief so that subdrain system may discharge to receiving swale, curb or storm drain system.

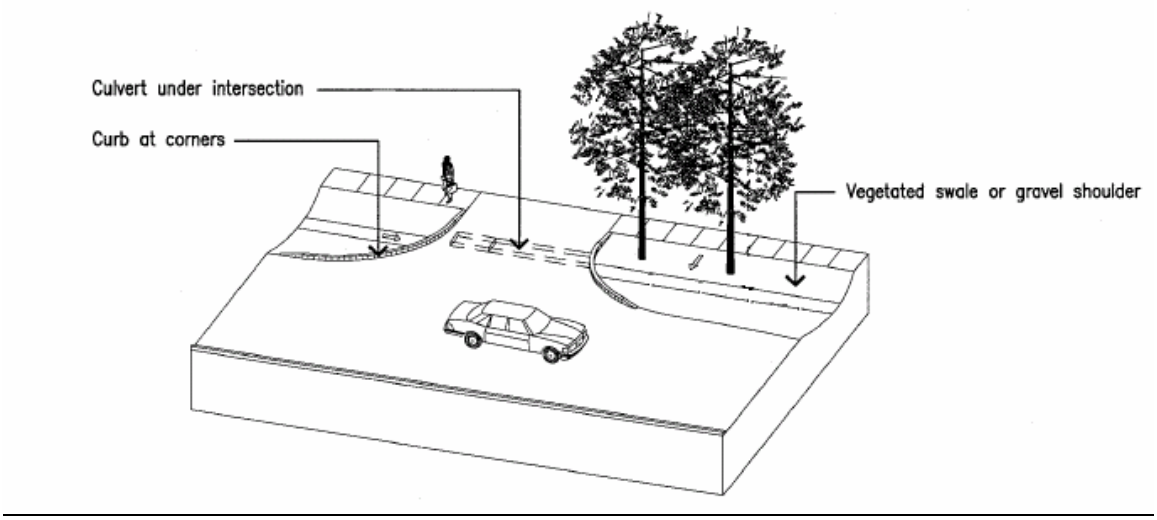
ECONOMICS

- Construction cost estimates for a bioretention area are slightly greater than those for the required landscaping for a new development (EPA, 1999).
- The operation and maintenance costs for a bioretention facility will be comparable to those of typical landscaping required for a site. (CASQA, 2003)
- Maintenance costs are projected at 5-7% of the construction cost annually.

REFERENCES

- California Stormwater Quality Association. (2003, January) California Stormwater BMP Handbook: New Development and Redevelopment.
- URS Australia Pty Ltd, (2004, May), Water Sensitive Urban Design: Technical Guidelines for Western Sydney, Upper Parramatta River Catchment Trust.
- US EPA (1999, September) BMP Fact Sheet 832-F-99-012. http://www.epa.gov/owm/mtb/biortn.pdf
- US EPA (1999, August) Preliminary Studies: Preliminary Data Summary of Urban Stormwater Best Management Practices. EPA-821-R-99-012 Part D.
- For additional information pertaining to Bioretention Systems, see the works cited in the San Diego County LID Literature Index.

Fact Sheet 18. Rural Swale Systems



Rural swale systems are a combination of street design elements that allow for surface drainage while simultaneously protecting the roadway edge, organizing parking, and allowing for driveway access and pedestrian circulation. Generally consist of street sheet flows being directed to a vegetated swale or gravel shoulder, curbs only at street corners, and culverts under driveways and street crossings

CHARACTERISTICS

- Shoulder can be designed to accommodate parking or to serve as a linear swale, permitting infiltration of stormwater along its entire length.
- Runoff from the street is not concentrated, but dispersed along its entire length, and build-up of pollutants in the soil is minimized.

APPLICATION

- Differing systems can be applied depending on the local characteristics, needs and zoning standards.

DESIGN

- Concrete curb and gutter not required.
- Ensure that culverts under intersections drain, to avoid standing water and resulting septic condition.
- For steeper slopes, roadside swales should be protected to minimize erosion.
- Provide concrete curb at intersection radii to protect roadway edge and landscape area from turning movements.
- Crown street to direct runoff to shoulders. If drainage is provided on one side only, then provide cross-slope towards swale.
- Protect pavement edge with rigid header of steel, wood or a concrete band poured flush with the street surface.

- If parking is not desired on the shoulder, no parking signs and striping can be used.
- Central medians can be used to divide traffic for safety or aesthetics.

MAINTENANCE

- Surface systems require periodic maintenance and inspection.
- Maintenance for surface systems is different than most urban Public Works Departments currently practice, and employee retraining may be required.
- Surface drainage systems are easier to monitor and clear than underground systems, because problems, when they occur, are visible and on the surface. This eliminates the need for subsurface inspection or street excavation.

LIMITATIONS

- Design and scope is dependant upon local conditions and zoning standards.

ECONOMICS

- Surface swales are less costly to install than underground pipe systems, but may have higher on-going maintenance costs.

REFERENCES

- City of Folsom, CA.
- For additional information pertaining to Rural Swale Systems, see the works cited in the San Diego County LID Literature Index.

Fact Sheet 24. LID Driveway, Sidewalk, and Bike Path Design

CHARACTERISTICS

Driveways, sidewalks and bike paths are another source of impervious coverage that can adversely affect water quality by the runoff generated from their surface. Several management opportunities and strategies are available to reduce this impact, including:

- Reducing sidewalks to one side of the street.
- Utilize shared driveways to provide access to several homes.
- Disconnect bike paths from streets. Bike paths separated from roadways by vegetated strips reduce runoff and traffic hazards.
- Utilizing pervious materials to infiltrate or increase time of concentration of storm flows.
- Reducing driveway and sidewalk width when possible.
- Directing driveway and sidewalk runoff to adjacent vegetation to capture, infiltrate, and treat runoff.
- Installing a bioretention area or swale between the street and sidewalk and grading runoff from the sidewalk to these areas.
- Planting trees between the sidewalk and streets to capture and infiltrate runoff.
- Installing grated infiltration systems in sidewalks and bike paths to receive runoff as sheet flow. These can be installed to protect trees or can provide off-line stormwater management via a grate over an infiltration trench.

APPLICATION

- Residential Subdivisions, single family and multi-family homes.
- Commercial Development
- Public Parks

DESIGN

- Grade driveways, sidewalks, and bike paths at a two percent slope to direct runoff to an adjacent vegetated area.
- Pervious materials such as permeable pavers, permeable concrete or asphalt, gravel, or mulch can be utilized for sidewalk surfaces.
- In some cases, sidewalks and bike paths can be placed between rows of homes to increase access and decrease overall effective imperviousness.
- Grated infiltration systems should include removable grates to allow for maintenance, and must be capable of bearing the weight of pedestrians.

LIMITATIONS

- Ordinances may require sidewalks on both sides of the street.
- Groundwater table must not be within 10 feet of the bottom of infiltration trenches.

MAINTENANCE CONSIDERATIONS

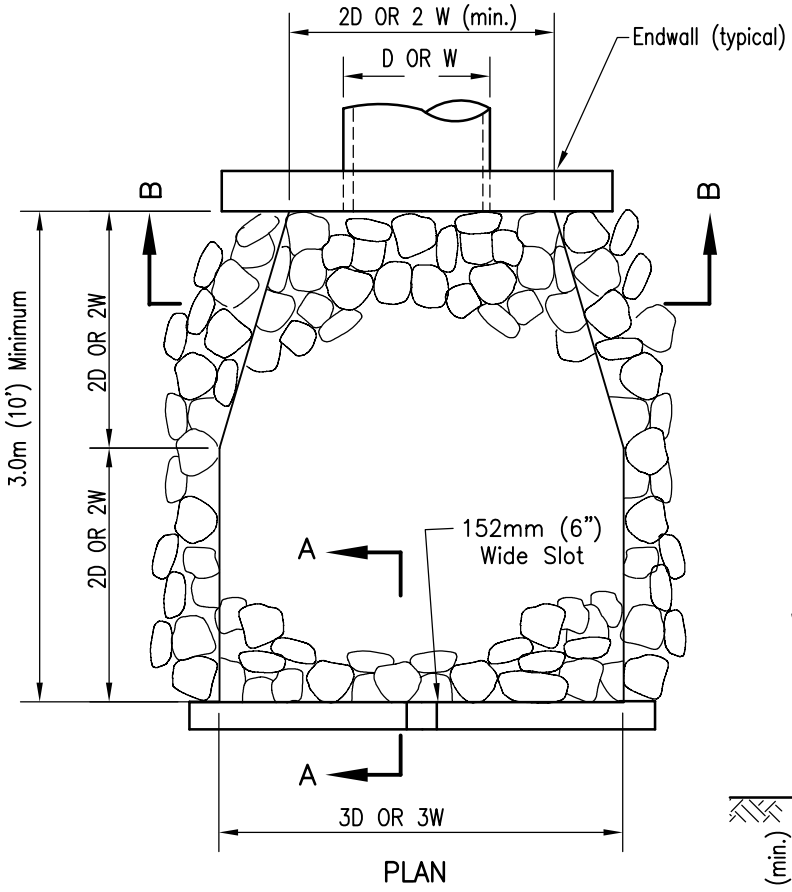
- Maintenance necessary is related to the techniques applied (permeable materials, bioretention, swales).
- Vector breeding may occur in bioretention and swales if not properly designed or maintained.

ECONOMICS

- Costs are related to the number, type and size of the techniques applied.

REFERENCES

- For additional information pertaining to LID Driveway, Sidewalk, and Bike Path Design see the works cited in the San Diego County LID Literature Index.



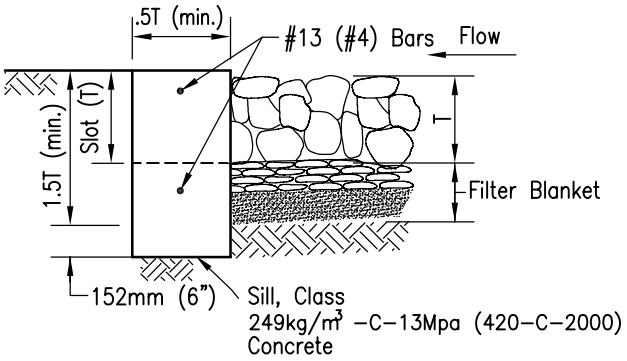
PLAN

Design Velocity m/sec (ft/sec)*	Rock Classification	T (min)
1.8–3 (6–10)	No. 2 Backing	320mm (1.1ft)
3–3.7 (10–12)	220 kg (1/4 ton)	823mm (2.7ft)
3.7–4.3 (12–14)	450 kg (1/2 ton)	1.1m (3.5ft)
4.3–4.9 (14–16)	900 kg (1 ton)	1.3m (4.4ft)
4.9–5.5 (16–18)	1.8 tonne (2 ton)	1.6m (5.4ft)

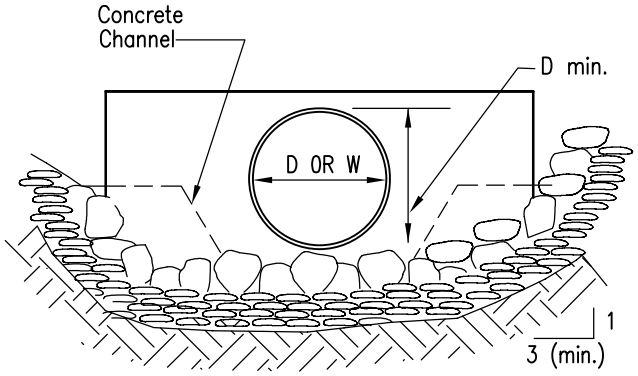
*over 5.5 mps (18 fps) requires special design

D = Pipe Diameter

W = Bottom Width of Channel



SECTION A–A



SECTION B–B

NOTES

1. Plans shall specify:
   A) Rock Class and thickness (T).
   B) Filter material, number of layers and thickness.
2. Rip rap shall be either quarry stone or broken concrete (if shown on the plans.) Cobbles are not acceptable.
3. Rip rap shall be placed over filter blanket which may be either granular material or filter fabric (woven filter slit film fabric shall not be used).
4. See Regional Supplement Amendments for selection of filter blanket.
5. Rip rap energy dissipators shall be designated as either Type 1 or Type 2. Type 1 shall be with concrete sill; Type 2 shall be without sill.

Revision	By	Approved	Date
ORIGINAL		Kercheval	12/75
Add Metric		T. Stanton	03/03
Add Rip Rap Table		S. Brady	04/06

SAN DIEGO REGIONAL STANDARD DRAWING

RIP RAP ENERGY DISSIPATOR

RECOMMENDED BY THE SAN DIEGO REGIONAL STANDARDS COMMITTEE

04/27/2006

Chairperson R.C.E. 19246 Date

DRAWING NUMBER **D-40**

ATTACHMENT F: OPERATIONS AND MAINTENANCE PLAN

Operations & Maintenance of BMPs is essential for the success of any SUSMP. In order to perform proper O&M the Redding Minor Subdivision (TPM 21112) will be required to maintain and inspect their Post Construction BMPs for the life of the project. An inspection schedule and maintenance directions must be prepared for each Post Construction BMP that is install on the project site.

INSTALLED POST CONSTRUCTION BMP DEVICES

The Redding Minor Subdivision (TPM 21112) utilizes rock swales and vegetated swales.

INSPECTION FORM

The Redding Minor Subdivision (TPM 21112) may use the attached form to keep a record of inspection and maintenance activities. The County of San Diego will have the required length of time that records must be kept, but keep in mind that the County of San Diego or the Regional Water Quality Control Board can ask for inspection and maintenance records for up to five years from the time that they occur. The attached form is general and blank and is intended to be copied for use.

VEGETATED SWALES

The following is inspection and maintenance information for the vegetated swales:

Routine Action: Height of Vegetation

Maintenance Indicator:	Height of vegetation exceeds 12”
Field Measurements:	Visual Inspection
Inspection Frequency:	- Once per Wet Season - Once per Dry Season
Maintenance Activity:	Cut vegetation to 6”
Additional:	Remove any trees or woody vegetation

Routine Action: Assess Vegetative Cover

Maintenance Indicator: Less than 70% vegetation coverage

Field Measurements:
- Visual Inspection
- Record barren areas
- File as a persistent problem

Inspection Frequency:
- Every May
- Late each Wet Season
- Late each Dry Season

Maintenance Activity:
- Reseed/re-vegetate barren areas by November
- Scarify area to restored and replant to 2" height
- If this is required two (2) seasons in a row then an erosion blanket will need to be installed prior to the third reseeding/re-vegetation.

Routine Action: Inspect for Debris Accumulation

Maintenance Indicator: Debris or litter present

Field Measurement: Visual Inspection

Inspection Frequency: Periodic

Maintenance Activity: Remove debris and trash and dispose of properly

Routine Action: Inspect for Accumulated Sediment

Maintenance Indicator:
- Sediment at or near vegetation height
- Channeling of flow
- Inhibited flow due to shallow slope

Field Measurement: Visual Inspection

Inspection Frequency: Annual

Maintenance Activity:
- Remove sediment
- If flow is channeled, determine cause and correct
- If sediment is deep enough to change flow gradient then remove all sediment during the dry season (May) and re-vegetate. Notify the City Engineer to determine if re-grading is required.

Routine Action: Inspect for Burrows

Maintenance Indicator:	Burrows, holes or mounds
Field Measurement:	Visual Inspection
Inspection Frequency:	- Annual - After vegetation trimming
Maintenance Activity:	Backfill burrows where seepage, erosion or leakage occur

Routine Action: General Maintenance Inspection

Maintenance Indicator:	Any damaged aspects (side slopes, inlet)
Field Measurement:	Visual Inspection
Inspection Frequency:	- Late each Wet Season - Late each Dry Season
Maintenance Activity:	Take corrective action prior to wet season

ROCK SWALES

The following is inspection and maintenance information for the rock swales:

Routine Action: Height of Vegetation

Maintenance Indicator:	Vegetation Present
Field Measurements:	Visual Inspection
Inspection Frequency:	- Once per Wet Season - Once per Dry Season
Maintenance Activity:	Remove any vegetation

Routine Action: Assess Rock Cover

Maintenance Indicator:	Less than 70% vegetation coverage
Field Measurements:	- Visual Inspection - Record barren areas - File as a persistent problem
Inspection Frequency:	- Every May - Late each Wet Season - Late each Dry Season
Maintenance Activity:	- Replace rock as needed to mitigate barren spots

Routine Action: Inspect for Debris Accumulation

Maintenance Indicator:	Debris or litter present
Field Measurement:	Visual Inspection
Inspection Frequency:	Periodic
Maintenance Activity:	Remove debris and trash and dispose of properly

Routine Action: Inspect for Accumulated Sediment

Maintenance Indicator:	- Sediment at or near rock height - Channeling of flow - Inhibited flow due to shallow slope
Field Measurement:	Visual Inspection
Inspection Frequency:	Annual
Maintenance Activity:	- Remove sediment - If flow is channeled, determine cause and correct - If sediment is deep enough to change flow gradient then remove all sediment during the dry season (May) and re-distribute rock. Notify the Agency Engineer to determine if re-grading is required.

Routine Action: Inspect for Burrows

Maintenance Indicator:	Burrows, holes or mounds
Field Measurement:	Visual Inspection
Inspection Frequency:	- Annual - After rock re-distributions
Maintenance Activity:	Backfill burrows where seepage, erosion or leakage occurs and re-distribute rock

Routine Action: General Maintenance Inspection

Maintenance Indicator:	Any damaged aspects (side slopes, rip rap)
Field Measurement:	Visual Inspection
Inspection Frequency:	- Late each Wet Season - Late each Dry Season
Maintenance Activity:	Take corrective action prior to wet season

BMP INSPECTION FORM

GENERAL INFORMATION				
Project Name				
City Contract No				
Contractor				
Inspector's Name				
Inspector's Title				
Signature				
Date of Inspection				
Inspection Type (Check Applicable)	r Prior to forecast rain r 24-hr intervals during extended rain		r After a rain event r Other _____	
Season (Check Applicable)	r Rainy (Wet)		r Non-Rainy (Dry)	
Storm Data	Storm Start Date & Time:		Storm Duration (hrs):	
	Time elapsed since last storm (Circle Applicable Units)	Min. Hr. Days	Approximate Rainfall Amount (mm)	

NOTES: _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

INSPECTION REQUIREMENTS				
Requirement	**Yes**	**No**	**N/A**	**Corrective Action**
Vegetated Swales				
Is the height of vegetation less than 12”?				
Is the vegetation coverage 70% or more?				
Is there debris or litter present?				
Is the channel sedimented?				
Are there burrows, mounds, or holes present?				
Is there any damage to the vegetated swales?				
Rock Swales				
Is there vegetation?				
Is the rock coverage 70% or more?				
Is there debris or litter present?				
Is the channel sedimented?				
Are there burrows, mounds, or holes present?				
Is there any damage to the rock swales?				

NOTES: _____

ATTACHMENT G: FISCAL RESOURCES

The property owner is aware that they will be required to maintain their selected post construction BMPs. The project's BMPs are First Category BMPs per the County of San Diego SUSMP (3-24-08) and therefore require no funding; however, the property owner is aware that the following 'Mechanisms to Assure Maintenance' apply to all installed First Category BMPs:

1. ***Stormwater Ordinance Requirement:*** The WPO requires this ongoing maintenance. In the event that the mechanisms below prove ineffective, or in addition to enforcing those mechanisms, civil action, criminal action or administrative citation could also be pursued for violations of the ordinance.

2. ***Public Nuisance Abatement:*** Under the WPO failure to maintain a BMP would constitute a public nuisance, which may be abated under the Uniform Public Nuisance Abatement Procedure. This provides an enforcement mechanism additional to the above, and would allow costs of maintenance to be billed to the owner, a lien placed on the property, and the tax collection process to be used.

FUNDING

Per Chapter 5: Maintenance Requirements for Treatment BMPs from the County of San Diego SUSMP for Land Development and Public Improvement Projects (3-24-08) the funding for First Category BMPs is listed as 'None Required.'

ATTACHMENT H: CERTIFICATION SHEET

I hereby declare that I am the engineer of work for this project, that I have exercised responsible charge over the design of the project as defined in Section 6703 of the Business and Professions code, and that the design is consistent with current standards.

I understand that the check of this SWMP by the County of San Diego is confined to a review only and does not relieve me, as engineer of work, of my responsibilities for project design.

In addition, I hereby certify that *'The proposed construction and post construction BMPs will reduce to the maximum extent practicable, the expected pollutants and will not adversely impact the beneficial uses or water quality of the project's downstream receiving waters'.*

---------- ----------

GARY WYNN **DATE**

REGISTERED CIVIL ENGINEER

ATTACHMENT I – SWMP ADDENDUM

This Storm Water Management Plan Addendum consists of all the extra information that is required by the County of San Diego in their Storm Water Management Plan – Major form.

1.0 TABLE 3 – STORMWATER QUALITY DETERMINATION

This section consists of provides the answers to the questions in the Table 3 of the County of San Diego Major SWMP form.

1. *Describe the topography of the project area.* The existing site topography is classified as hilly to steep slopes.

2. *Describe the local land use within the project area and adjacent areas.* The existing local land use is residential. The proposed Minor Subdivision does not propose to chance the local land use.

3. *Evaluate the presence of dry weather flow.* Septic system design has determined that there are no dry weather flows in the project site at this time.

4. *Determine the receiving waters that may be affected by the project throughout all phases of development (i.e., construction, maintenance and operation).* The downstream receiving waters for the project site is Lake Hodges via the Del Dios HSA as Hydrologic Unit Basin Number 905.21 of the San Diego Region 9 Basin Plan. The storm water runoff must travel roughly 3 miles overland and through various storm drain systems to get to Lake Hodges.

5. *For the project limits, list the 303(d) impaired receiving water bodies and their constituents of concern.* The project site's ultimate receiving waters is Lake Hodges. Lake Hodges is listed on the 'Proposed 2006 CWA Section 303(d) List of Water Quality Limited Segments' provided by the San Diego Regional Board as being impaired by the following pollutant/stressors:
   - Color
   - Manganese\Nitrogen
   - pH
   - Phosphorus
   - Turbidity

6. *Determine if there are any High Risk Areas (which is defined by the presence of municipal or domestic water supply reservoirs or groundwater percolation facilities) within the project limits.* Lake Hodges is the ultimate receiving waters for the project site's storm water runoff and is listed as having Ground Water Beneficial Uses per the Region 9 Basin Plan. Please see the attached excerpt from the Region 9 Basin Plan.

7. *Determine the Regional Board special requirements, including TMDLs, effluent limits, etc.* The project site's receiving waters is not listed on the 'Proposed 2006 CWA Section 303(d) List of Water Quality Limited Segments Being Addressed by USEPA Approved TMDLS' provided by the San Diego Regional Board. Please see the attached statement.

8. *Determine the general climate of the project area. Identify annual rainfall and rainfall intensity curves.* The general climate for the project site is coastal desert. Rainfall information is determined in the project's hydrology report. This is a separate document under the same County of San Diego project number.

9. *If considering Treatment BMPs, determine the soil classification, permeability, erodibility, and depth to groundwater.* The soil classification has been determined to be 'Soil Type C' per the County of San Diego Hydrology Manual (2003 edition). Please see the attached reference.

10. *Determine contaminated or hazardous soils within the project area.* The project site is not anticipated to have any contaminated or hazardous soils within the project area. At this time a soils report has not been performed for the project site.

11. *Determine if the project is within the environmentally sensitive areas as defined on the maps in Appendix A of the County of San Diego Standard Urban Storm Water Mitigation Plan for Land Development and Public Improvement Projects.* The project site is not located in an Environmentally Sensitive Area as defined in Appendix A of the County of San Diego SUSMP.

12. *Determine if this is an emergency project.* This is not an emergency project.

2.0 LID TABLE 7 INFORMATION

This section consists of provides the additional answer to questions in Table 8 of the County of San Diego Major SWMP.

1. *Conserve Natural Areas:* The project site will be preserving natural areas by grading as minimally as feasible. Development has also been clustered to limit impacts to the adjacent natural areas.

2. *Minimize Disturbances to Natural Drainages:* The project site has two natural drainages. These areas have been identified and are being disturbed as little as possible.

3. *Minimize and Disconnect Impervious Surfaces:* The project site drains all runoff to vegetated and rock swales and then discharges to the natural areas with non-erosive velocities by using rip rap energy dissipation devices.

3.0 PROPOSED 2006 CWA SECTION 303(d) LIST OF WATER QUALITY LIMITED SEGMENTS

The project site receiving water is listed on the *'Proposed 2006 CWA Section 303(d) List of Water Quality Limited Segments*.' This list is lengthy and only the project's listings are included in this report as reference.

4.0 PROPOSED 2006 CWA SECTION 303(d) LIST OF WATER QUALITY LIMITED SEGMENTS – USEPA APPROVED TMDL BEING ADDRESSED BY USEPA APPROVED TMDLS

The project site receiving water is not listed on the 'Proposed 2006 CWA Section 303(d) List of Water Quality Limited Segment – USEPA Approved TDML Being Addressed by USEPA Approved TMDLs.' This list is lengthy and is not included in this report as reference since the project site is not listed on it.

5.0 CONCLUSION

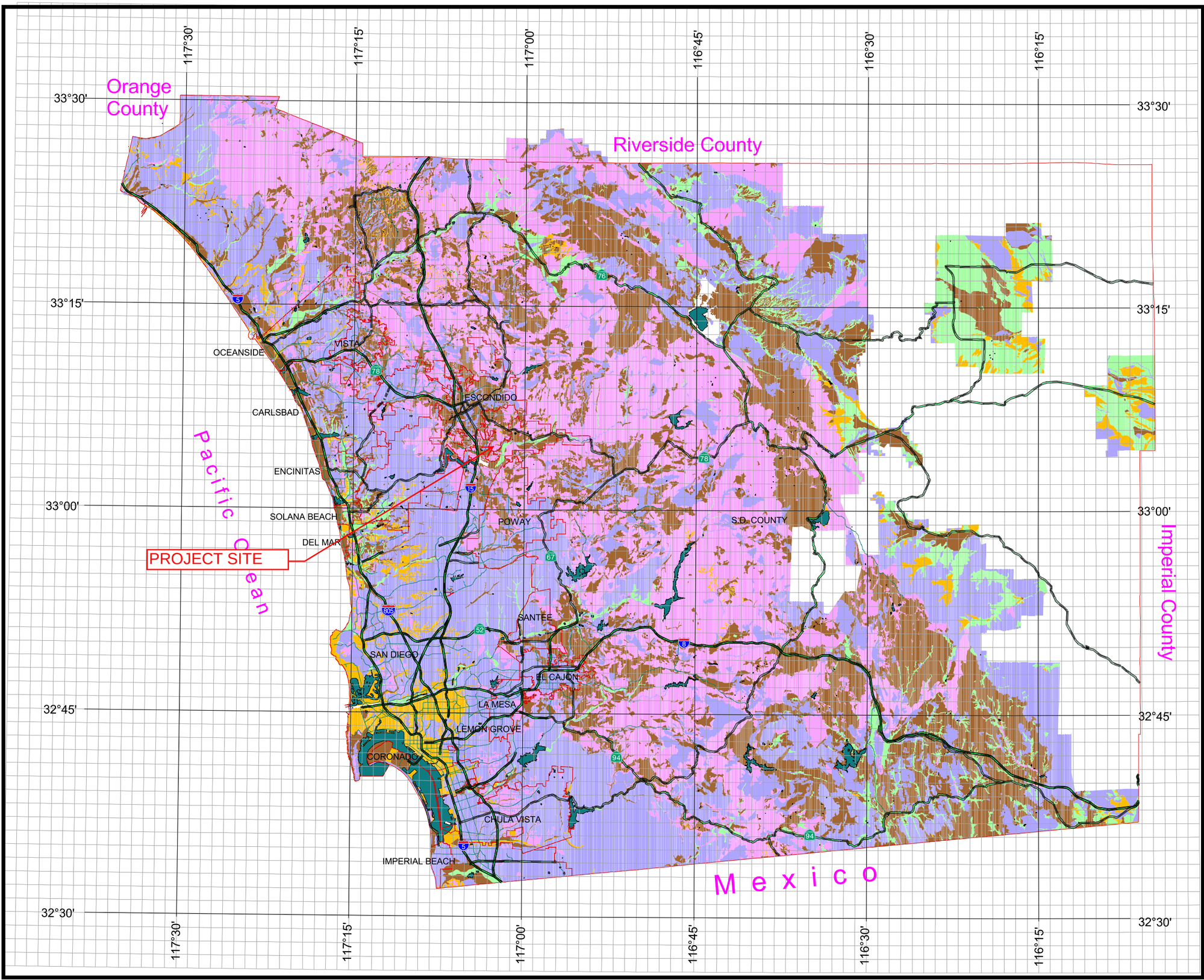
Vegetated swales were selected to mitigate the project's storm water discharge. Velocities will be mitigated by using rock swales and rip rap energy dissipaters on the pads and at various other locations on site. Individual owners will be required to maintain their vegetated swales as built. All vegetated swales discharge to the local native vegetation that contributes to the local drainage course.

Individual property owners will be fiscally responsible for maintaining their vegetated swales, rock swales, and rip rap energy dissipaters. The annual cost for maintaining vegetated swales is on the order of $3000 per the County of San Diego Storm Water Standards.

Impact Statement: The proposed construction and post construction BMPs will reduce to the maximum extent practicable, the expected pollutants and will not adversely impact the beneficial uses or water quality of the project's downstream receiving waters.

County of San Diego Hydrology Manual

Soil Hydrologic Groups



Legend

Soil Groups

- Group A
- Group B
- Group C
- Group D
- Undetermined
- Data Unavailable

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
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N
W E
S

3 0 3 Miles

Table 2-2. BENEFICIAL USES OF INLAND SURFACE WATERS

Inland Surface Waters [1, 2]	Hydrologic Unit Basin Number	BENEFICIAL USE														
		MUN	AGR	IND	PROC	GWR	FRSH	POW	REC1	REC2	BIOL	WARM	COLD	WILD	RARE	SPWN
San Dieguito River Watershed – continued																
Santa Maria Creek	5.32	●	●	●	●				○	●		●		●		
unnamed intermittent streams	5.33	●	●	●	●				○	●		●		●		
unnamed intermittent streams	5.34	●	●	●	●				○	●		●		●		
San Dieguito River	5.32	●	●	●	●				○	●		●		●	●	
Cloverdale Creek	5.32	●	●	●	●				○	●		●		●	●	
San Dieguito River	5.21	●	●	●	●				●	●	●	●	●	●	●	
Highland Valley	5.31	●	●	●	●				○	●		●		●		
Lake Hodges	5.21	See Reservoirs & Lakes – Table 2-4														
Kit Carson Creek	5.21	●	●	●	●	○			●	●		●		●	●	
West Branch Kit Carson Creek	5.24	●	●	●	●	○			●	●		●		●		
East Branch Kit Carson Creek	5.24	●	●	●	●	○			●	●		●		●		
Green Valley Creek	5.21	●	●	●	●	○			●	●		●		●		
Green Valley Creek	5.22	●	●	●	●	○			●	●		●		●		
Felicita Creek	5.23	●	●	●	●	○			●	●		●		●		
West Fork Felicita Creek	5.23	●	●	●	●	○			●	●		●		●		
East Fork Felicita Creek	5.23	●	●	●	●	○			●	●		●		●		

● Existing Beneficial Use

○ Potential Beneficial Use

[1] Waterbodies are listed multiple times if they cross hydrologic area or sub area boundaries.

[2] Beneficial use designations apply to all tributaries to the indicated waterbody, if not listed separately.

Table 2-2. BENEFICIAL USES OF INLAND SURFACE WATERS

Inland Surface Waters [1, 2]	Hydrologic Unit Basin Number	BENEFICIAL USE														
		MUN	AGR	IND	PROC	GWR	FRSH	POW	REC1	REC2	BIOL	WARM	COLD	WILD	RARE	SPWN
San Dieguito River Watershed - continued																
San Dieguito Reservoir	5.21	See Reservoirs & Lakes – Table 2-4														
Warren Canyon	5.21	●	●	●	●				●	●	●	●	●	●		
San Bernardo Valley	5.21	●	●	●	●				●	●		●		●	●	
unnamed intermittent streams	5.24	●	●	●	●				●	●		●		●		
unnamed intermittent streams	5.23	●	●	●	●				●	●		●		●		
unnamed intermittent streams	5.22	●	●	●	●				●	●		●		●		
San Dieguito River	5.11	+	○	○					●	●		●	●	●		●
Lusardi Creek	5.12	+	○	○					●	●		●		●		
Lusardi Creek	5.11	+	○	○					●	●		●		●		
La Zanja Canyon	5.11	+	○	○					●	●		●		●		
Gonzales Canyon	5.11	+	○	○					●	●		●		●		
San Dieguito Lagoon	5.11	See Coastal Waters – Table 2-3														
Los Penasquitos Creek Watershed																
Los Penasquitos Lagoon	6.10	See Coastal Waters – Table 2-3														
Soledad Canyon	6.10	+	●	●					○	●		●	●	●		
Carol Canyon	6.10	+	●	●					○	●		●	●	●	●	

● Existing Beneficial Use

○ Potential Beneficial Use

\+ Excepted from MUN (See Text)

[1] Waterbodies are listed multiple times if they cross hydrologic area or sub area boundaries.

[2] Beneficial use designations apply to all tributaries to the indicated waterbody, if not listed separately.

Table 2-4. BENEFICIAL USES OF RESERVOIRS AND LAKES

Reservoirs & Lakes	Hydrologic Unit Basin Number	BENEFICIAL USE												
		MUN	AGR	IND	PROC	GWR	FRSH	REC1	REC2	WARM	COLD	WILD	RARE	POW
O'Neill Lake	2.13	●	●	●	●			●	●	●	●	●	●	
Diamond Valley Lake	2.35 & 2.36	●	●	●	●	●		●[1]	●	●	●	●		●
Lake Skinner	2.42	●	●	●	●	○		●[1]	●	●		●		
Vail Lake	2.81	●	●	●	●	●		●[1]	●	●		●		
Turner Lake	3.13	●	●	●				○	●	●				
Lake Henshaw	3.31	●	●	●	●		●	●[1]	●	●		●	●	●
Olivenhain Reservoir	5.21	●		●				●[1]	●	●	●	●		●
San Dieguito Reservoir	5.21	●	●	○				●	●	●	●	●		
Lake Dixon	4.62	●	●	○				●[1]	●	●	●	●		
Lake Wohlford	4.63	●	●	○				●[1]	●	●	●	●		●
Lake Hodges	5.21	●	●	●	●			●[1]	●	●	●	●	●	
Lake Poway	5.52	●	●	●	●			●[1]	●	●	●	●		
Sutherland Lake	5.53	●	●	●	●			●[1]	●	●	●	●	●	
Miramar Reservoir	6.10	●		●				●[1]	●	●		●		●
Lake Murray	7.11	●		●				●[1]	●	●	●	●		●
Lake Jennings	7.12	●		●				●	●	●	●	●		

[1] Fishing from shore or boat permitted, but other water contact recreational (REC-1) uses are prohibited.

● Existing Beneficial Use

○ Potential Beneficial Use

PROPOSED 2006 CWA SECTION 303(d) LIST OF WATER QUALITY LIMITED SEGMENTS

SAN DIEGO REGIONAL BOARD

SWRCB APPROVAL DATE: OCTOBER 25, 2006

REGION	TYPE	NAME	CALWATER WATERSHED	POLLUTANT/STRESSOR	POTENTIAL SOURCES	ESTIMATED SIZE AFFECTED		PROPOSED TMDL COMPLETION
				Total Dissolved Solids		6.4	Miles	2019
				Impairment Located at lower 1 mile.				
					Agricultural Return Flows			
					Urban Runoff/Storm Sewers			
					Flow Regulation/Modification			
					Unknown Nonpoint Source			
					Unknown point source			
9	R	Green Valley Creek	90521000					
				Chloride		0.98	Miles	2019
					Source Unknown			
				Manganese		0.98	Miles	2019
					Source Unknown			
				Pentachlorophenol (PCP)		0.98	Miles	2019
					Source Unknown			
				Sulfates		0.98	Miles	2019
					Urban Runoff/Storm Sewers			
					Natural Sources			
					Unknown Nonpoint Source			
					Unknown point source			
9	L	Guajome Lake	90311000					
				Eutrophic		33	Acres	2019
					Nonpoint/Point Source			
9	L	Hodges, Lake	90521000					
				Color		1104	Acres	2019
					Urban Runoff/Storm Sewers			
					Unknown Nonpoint Source			
					Unknown point source			
				Manganese		1104	Acres	2019
					Source Unknown			

PROPOSED 2006 CWA SECTION 303(d) LIST OF WATER QUALITY LIMITED SEGMENTS

SAN DIEGO REGIONAL BOARD

SWRCB APPROVAL DATE: OCTOBER 25, 2006

REGION	TYPE	NAME	CALWATER WATERSHED	POLLUTANT/STRESSOR	POTENTIAL SOURCES	ESTIMATED SIZE AFFECTED		PROPOSED TMDL COMPLETION
				Nitrogen		1104	Acres	2019
					Agriculture			
					Dairies			
					Urban Runoff/Storm Sewers			
					Unknown Nonpoint Source			
					Unknown point source			
				pH		1104	Acres	2019
					Source Unknown			
				Phosphorus		1104	Acres	2019
					Agriculture			
					Dairies			
					Urban Runoff/Storm Sewers			
					Unknown Nonpoint Source			
					Unknown point source			
				Turbidity		1104	Acres	2019
					Source Unknown			
9	R	Kit Carson Creek	90521000					
				Pentachlorophenol (PCP)		0.99	Miles	2019
					Source Unknown			
				Total Dissolved Solids		0.99	Miles	2019
					Agricultural Return Flows			
					Urban Runoff/Storm Sewers			
					Flow Regulation/Modification			
					Unknown Nonpoint Source			
					Unknown point source			
9	R	Laguna Canyon Channel	90112000					
				Sediment Toxicity		1.6	Miles	2019
					Source Unknown			